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# ENGINEERING AND MINING JOURNAL-PRESS

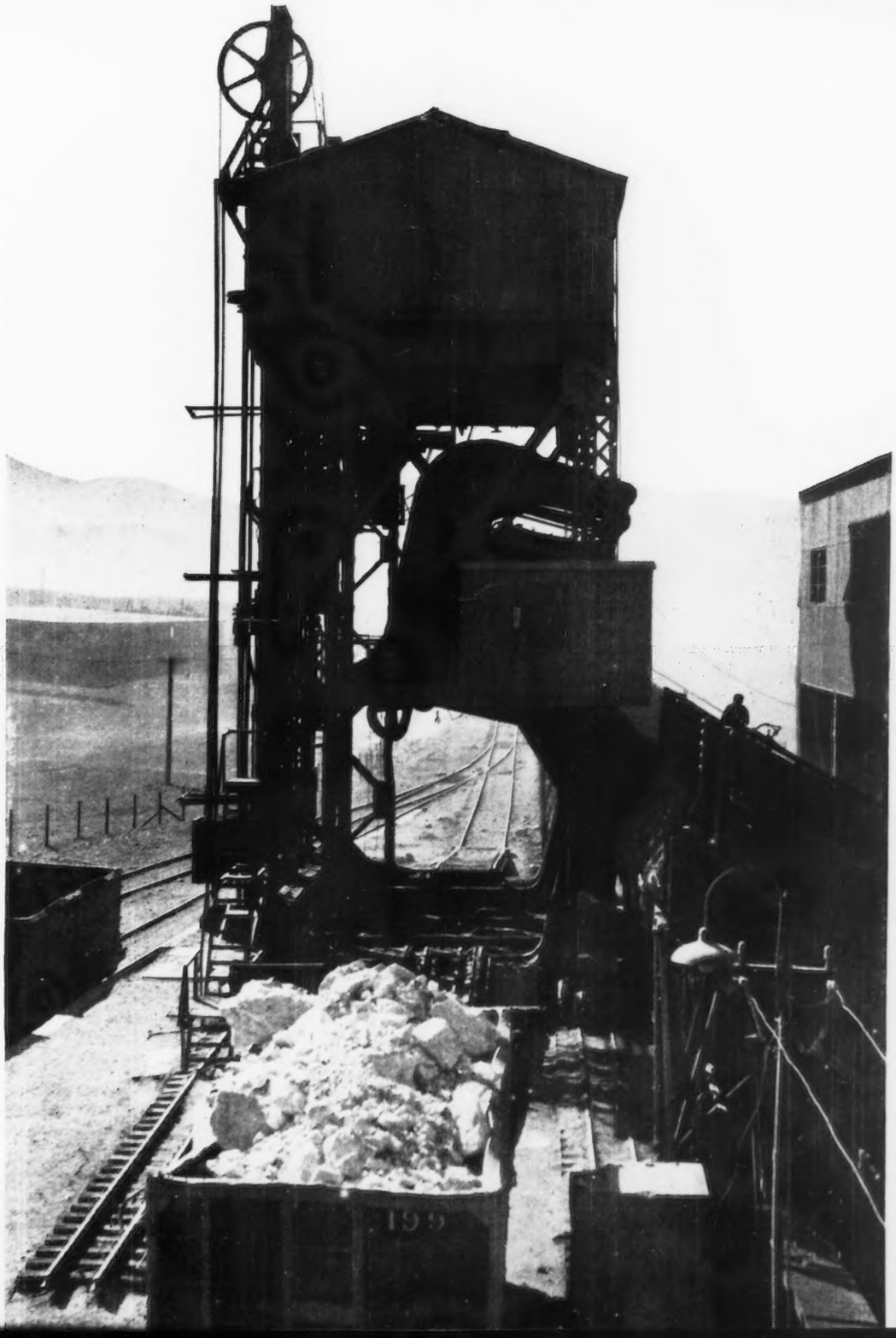
A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

## Drilling and Blasting Underground At United Verde Mine

By C. E. Mills

## Making Sponge Iron In Australia

By P. M. Bonnerup



## How to Make Lump Rock in a Limestone Mine

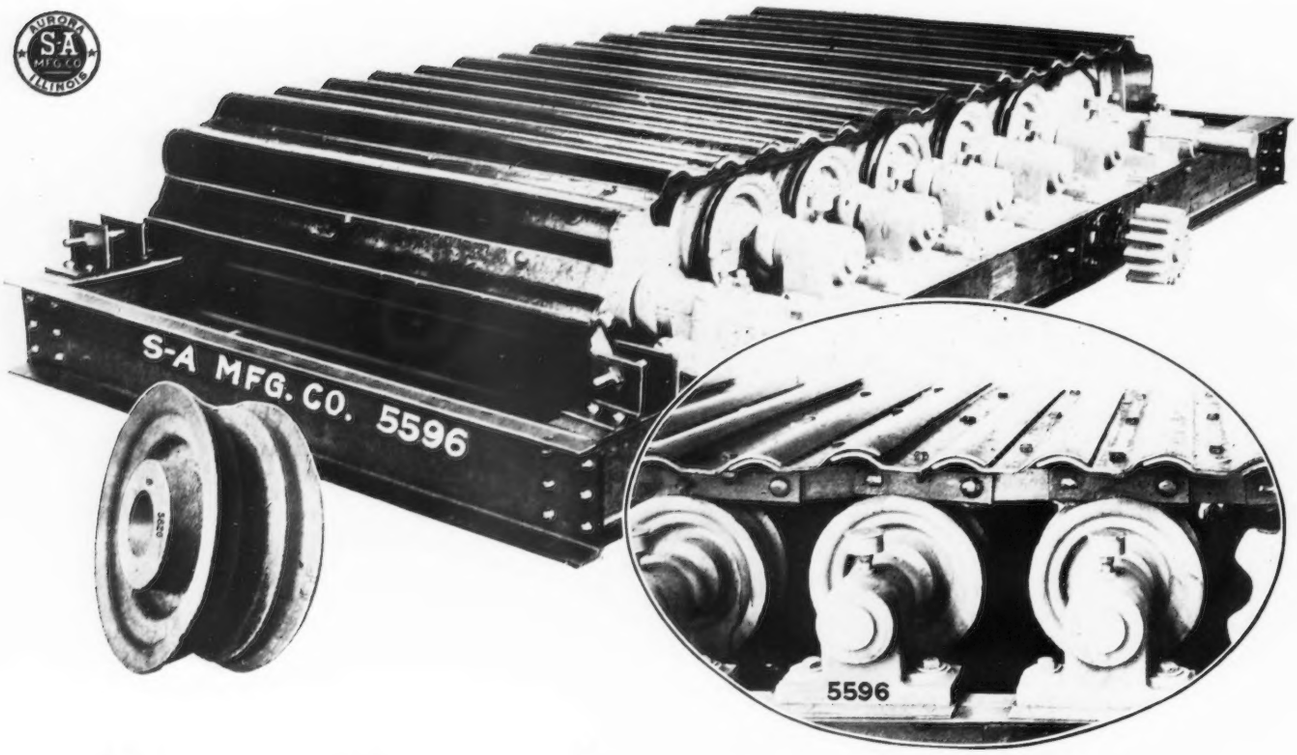
By Ralph W. Smith

## Genesis of Chilean Nitrate

By James E. Harding

Chile Copper Co.'s Car Dumper In Action

Ore trains loaded by steam shovel at the open cut mine 2½ miles away are dumped

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J. E. SPURR, Editor

GEORGE J. YOUNG, Associate Editor, San Francisco, Calif. T. A. RICKARD, Contributing Editor, San Francisco, Calif.
A. H. HUBBELL, Managing Editor
E. H. ROBIE, A. B. PARSONS, ALBERT H. FAY, W. N. P. REED, Assistant Editors
Tenth Ave. at 36th St., New York, N. Y.
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## Contents

*Illustrated Article

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**Editorials** 873
- Development of Prospects
- Exaggerating Clouds in Mexico
- Behind the Scenes
- England and the Continent
- Ventilation at the Village Deep Mine

***Stoping at United Verde** 876
- Illustrations

***Drilling and Blasting Underground at United Verde Mine** 877
- By C. E. Mills

***How to Make Lump Rock in a Limestone Mine** 882
- By Ralph W. Smith

***Genesis of Chilean Nitrate** 885
- By James E. Harding

***Making Sponge Iron in Australia** 889
- By P. M. Bonnerup

**Discussion** 892
- High Capitalization of Copper Companies Cuts Down Earnings Per Share
- Why He Discontinued
- Ore Deposition in the Tri-State District

**Consultation** 894
- Two Inquiries on Nickel
- Market for Bismuth
- Spodumene and Lithia
- Mineral Specimens

**Mining News** 895
- Safety Work of U. S. Steel
- Tariff Hearings
- Water Transportation to Red Lake Now Available
- Increased Canadian Asbestos Production
- Letters from Toronto, London, Melbourne, Johannesburg

**Societies, Address and Reports** 902

**Men You Should Know About** 903

**Obituaries** 903

**Recent Technical Publications** 904

***New Machinery** 905

**Markets** 907

**Company Reports** 909

**Prices of Mining Supplies** 911

**Mining Stocks** 912

**Searchlight Section** 28-30

**Professional Directory** 31

**What and Where to Buy** 34

**Advertising Index** 38

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JOSIAH EDWARD SPURR, Editor

*Volume* 121 New York, May 29, 1926 *Number* 22

## Development of Prospects

IT IS TRUE that there have been, now and then, valuable mines discovered whose surface showing was not sufficient to warrant mining. Development of deeper regions demonstrated orebodies of value, which did not outcrop. Such, for example, were the Tintic Standard, in Utah; the Lamartine mine, at Idaho Springs, Colo.; and that phenomenally rich silver mine, the Valenciana, at Guanajuato, in Mexico. On the other hand, for every mine of this type which proved richer in depth hundreds show good surface ore and offer great attractions for mining, but development in depth only demonstrates impoverishment and a failure of the pay ore to go down.

As the search for new mines continues, growing more and more difficult, the evaluation of a surface prospect becomes continually a matter for nicer judgment. When ore shows at the surface, there is no problem: the ore will be followed down or wherever it goes, to the end; and good mining demands that exploration should be carried substantially past the last bodies of pay ore. A certain amount of unprofitable deadwork should be anticipated and provided for in any wise and well-rounded mining operation. Many a mine has been prematurely abandoned because the cautiousness and economy of the manager would not let him venture far enough beyond the limits of his known ore. So many cases have passed into tradition of old mines being reopened and, with the first few rounds of shots, breaking into new ore, that the humorous maxim of the miner is never to quit till you have put in one shot more. Of course, this thoroughness must be limited by discretion and by a sense of proportion, in which the past performance of the mine, its geological condition, and the value of the ore will figure largely. The manager will feel his way along by balanced judgment, his program combining thoroughness and conservatism.

As to the great number of surface prospects which may develop more favorably in depth, still nicer judgment must be shown. While they may do this, the odds, numerically speaking, are by far greater that they will not. The disinclination of many large companies to spend money in developing prospects is based not so much on lack of enterprise as on experience; it is quite easy to go broke developing prospects. Here again the geological conditions and the nature and value of the ore must determine in each case what and how much to do in terms of work done and money spent. The size of the pile of the investigator, determining how much he can afford to gamble on a 1 to 10 shot, or a 1 to 50 shot, will also determine this policy, and what the engineer will recommend to his principals—and the personal element of his principals will also influence his decision.

The recent hearing in California to determine whether promotion stock of the Western Lead Mines Co. could be properly marketed without imposing upon the public brought forth opinions from the state mineralogists and other engineers that the property was a prospect only, not capable of having a definite value set upon it, but worthy of having some development money spent on it. An opinion was even given as to how much might thus be properly adventured, the estimates being from $150,000 to $190,000. While this gives an idea which expresses the diverse factors in the minds of the engineers, such a definite program must also include the element of the resources and personality of the owners thus contributing and risking. The picture would seem to be based on such owners or adventurers of substantial means, of the type of some of our large corporations and private capitalists. In this case, however, the money gambled is to come from the public in small sums and from people who could not afford to lose, but who had been enthused beyond reason by the rainbow utterances of the promoter, Mr. Julian. And in this case it would not appear to be good business for such clients to take the indicated chances in spending a substantial amount of development money upon a simple prospect, or for them to be allowed to be excited by high-powered salesmanship into such a venture.

## Exaggerating Clouds in Mexico

UNDER date of May 15, 1926, W. D. Thornton, president of the Greene Cananea Copper Co., in behalf of the directors, makes the following statement regarding the Mexican situation to the stockholders of the company:

> "The so-called 'Alien' law of Mexico, which has been the cause of much discussion and controversy during several years past, has recently been clarified by the publication of the official regulations, which in effect interpret the law and direct its enforcement. There appears to be nothing in the regulations as published that questions the right or title of mining companies or in any way hampers or interferes with their operation."

This is the most recent statement from responsible sources on a controversy in connection with which "confiscation" has been the favorite term of a portion of the American press. The annual report of the Phelps Dodge Corporation to its shareholders stated that "recent orders and regulations of the government, if insisted upon, will militate against efficient operation and greatly embarrass the management in the future." This may refer only to labor and tax legislation, or to the alien ownership law as well. In either event the date of this report is April 1; and in the interim from that date to May 15 the Mexican Government did much to clarify its position. The whole situation is unusually complicated, and the average well-informed citizen in the United States, whose "facts" generally come from sources that are contaminated with partisan propaganda, is in no position to form a judgment on the

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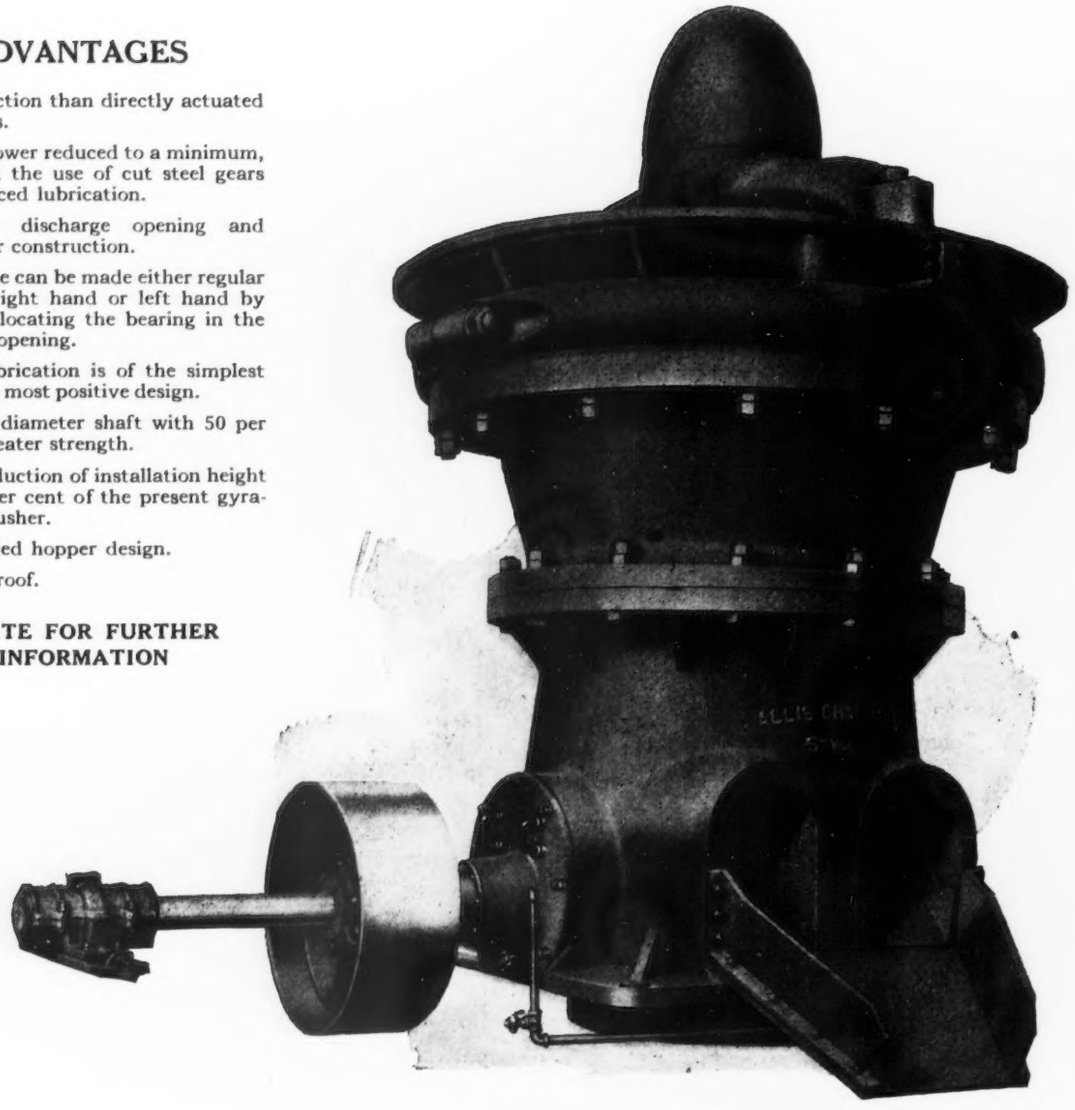

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men complained of so heartily in Germany a few years ago are now obtaining in their own country. It would seem that some really effective measure, such as the reduction of the interest rate on internal loans to 2 per cent, must be decided on. This would be a long step toward repudiation, say some French financiers, but surely even such a strenuous measure would be preferable to having the franc go the way of the mark. The Belgian franc is suffering likewise, dropping last week also to 3c. In Italy, Mussolini finds that he cannot raise the value of the lira, and his remarks do not seem to impress foreign observers with the stability of his government or its finances. In Poland, the new silver zloties which were coined in this country two or three years ago must have long since disappeared from circulation, for Polish currency has only a nominal value in foreign money marts; a revolution has taken place, and the patriotic Pilsudski finds himself in control of a pretty bad mess and his troubles only beginning. Germany has been suffering from a protracted trade depression, now seemingly somewhat on the mend; politically, conditions seem fairly stable, though it would seem that the government is suffering from too many parties, each of which hangs on tenaciously to its own small influence and power. All in all, Europe is now looked upon with more dissatisfaction by observers in the United States than at any time since the Dawes agreement became effective.

Prosperity in Europe, as has been pointed out in these columns before, is a very real requisite for the continued prosperity of many of the mining industries of America. Copper, lead, zinc, silver, gold, and nickel are all looking for an outlet there, and for some of these metals a good European demand is an essential, without which prices in the United States must surely fall. The European situation has perhaps been the most important factor in the recent decline in metal prices, for little reason can be found in domestic business conditions. So America must find a way to help Europe—to help her help herself. Cancellation of debts is freely suggested from the other side. Financially, the United States might find this easy, but the psychological effect would be decidedly bad; the self-respect of the European nations involved would certainly be lowered and the militaristic spirit even more certainly cultivated by the knowledge that wars do not have to be paid for. The better way is to help and encourage the Continental nations to emulate England. Though that country is still rather deep in the industrial woods, she is at least on the right path and has earned general confidence that she will find her way out.

## Ventilation at the Village Deep Mine

THE Village Deep mine, on the Rand, South Africa, is now the deepest mine in operation, as primary workings have been extended to a vertical depth of 7,052 ft., and the lowest development working is at a depth of 6,543 ft. The Morro Velho mine, in Brazil, and the Champion Reef mine, in the Mysore district of India, are two other mines which are also operating at depths about 6,000 ft. or more from the surface. Air temperature and air conditions are two critical limitations on mining at great depths, and the three mines mentioned are therefore of great technical interest to mining engineers. Temperature conditions at the Morro Velho and the Champion are more onerous than at the Village Deep. The ventilation conditions of this mine are described in considerable detail by M. O. Tillard and E. C. Ranson in the February number of the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa.

The active portion of the Village Deep from the 3,700 to the 6,543 level covers approximately 190 acres in projection, and about one-half of this appears to be worked out and filled. The main downcast air passes down a vertical shaft to a depth of 4,034 ft. and then by an incline to the lower levels of the mine, from which various splits are taken off on either side, to the development drives and stopes, through which it rises to an underground fan 3,700 ft. from the surface and is delivered through a worked-out section of the mine to upcasts leading to the surface. The first split is at a depth of 5,627 ft. Distribution is symmetrical on either side of the incline. Temperature gradient is one degree F. for each 219 ft. of vertical depth. At 6,869 ft. the rock temperature determined was 96.1 deg. F. The estimated rock temperature at 9,000 ft. vertical is given as 105.8 deg. F. Average winter and summer temperatures differ by 30 deg. F. at the surface, and the air entering the bottom split at 6,543 ft. is almost at constant temperature throughout the year.

It is of interest to note that the degree of cooling effected by the main intake air at the bottom split in the mine at any depth is 10 deg. F. less than the rock temperature; that the last through ventilation point on any level at any depth is 7 deg. F. less than rock temperature; that at the face of a drive with machines working a temperature 7 deg. F. less than the rock temperature can be maintained, and that the maximum temperature in a development dead end is 4 deg. F. less than rock temperature.

In working places a minimum wet kata-thermometer cooling rate of 7.5 milli-calories per square centimeter per second is maintained where there is a through ventilation current, but, as the authors of the article state, it is necessary to resort to intensive air coursing to insure sufficient velocity of the air current to approach this standard in the stopes. The velocity set as a standard is 100 ft. per minute, up the stope faces. In dead ends a minimum wet kata of 5 milli-calories per square centimeter per second is set as a standard, and blowers and air pipe are necessary to attain this. These kata minimums establish the depth of working under present conditions, and where the depth results in lower kata readings, air conditioning, either by partial dehydration or by pre-cooling, becomes necessary. At saturation and body temperature, air movement has little efficiency in cooling the body.

Artificial cooling or refrigeration and partial dehydration of the air close to working places offer the two most practicable methods of increasing the cooling effect of air currents. Both suggest opportunities to the physicist and the mechanical engineer in developing equipment for air conditioning. At Morro Velho a refrigeration plant was installed for the purpose of pre-cooling the mine air as it enters the main air course, but, although considerable cooling effect was obtained, the installation does not appear to have completely solved the problem. The economics of the situation would appear to indicate that local conditioning of the air would be a more promising line of attack than initial treatment of the whole ventilating current as it enters the mine.

questions involved. The large mining companies necessarily have representatives in Mexico City, who keep in the closest touch with developments, and Mr. Thornton knows what he is talking about. The Cananea properties lie in the so-called prohibited zone, comprising a strip 100 kilometers wide along the border; and as the regulations are most severe with respect to holdings in this area, it is safe to conclude that mining companies operating in other parts of the country have even less reason for apprehension.

Much has been published of a blustering character about what the United States ought to do in Mexico to protect the rights of American companies that they say are grievously infringed. *Liberty* about two months ago coolly advocated the seizure of Mexico by the United States, for the naïve reason that the Mexicans themselves could not develop the natural resources of the country adequately, and did not make it easy enough for others to help. "Clouds on the Mexican Horizon" is the caption of a series of characteristically prejudiced articles recently published in the *Wall Street Journal*. The suspicion is strong that many of the clouds in Mexico are inspired by people who believe that in some devious way they may help themselves to obtain something to which they are not entitled. It is significant that a large company, as vitally interested as the Greene Cananea Copper Co., so definitely reassures its shareholders.

## Behind the Scenes

THE FEDERAL GOVERNMENT engages in many activities, and its technical investigations are pretty well scattered. Now and then we observe a new investigation of this or that bureau by a Congressional committee—a checking up, so to speak, of some of the numerous appropriations and the administration abuses incidental to their disbursement; all of which is interesting and enlightening. The public and the mining engineers in general have seldom paused to see, or found sufficient interest or time to study, the administration of appropriations like that for the War Minerals Relief, Reclamation Service, and the Engineering Division under the Income Tax Unit, and many others, where large sums of money are involved.

The Civil Service Commission announced competitive examinations for valuation engineers under dates of Dec. 28, 1923, and Feb. 28, 1925, stipulating salaries of $3,600, $3,800, and $4,800. It is understood that no valuation engineers were appointed from the registers thus established, but the Income Tax Unit did secure a number of appointees from other lists as assistant valuation engineers by offering $200 per month, or about 60 per cent of the advertised salary. The announced compensation was certainly low enough without having to resort to subterfuge to make it still lower.

Another examination was scheduled for April 20, 1926, for valuation engineers at $3,800 and associates at $3,000 per year. It is reported that these candidates likewise will be offered $200 per month as assistant engineers, that being the entrance salary the personnel division of the Income Tax Unit is willing to pay for men to handle problems involving millions of dollars. This salary eliminates the older and more experienced men. The appointee must come in contact and cope with corporation presidents, managers, engineers, and attorneys, many of whom by long experience and business ability are receiving salaries of $15,000 to $50,000 per year. When a million dollars in taxes is involved, the taxpayer does not send a $200-a-month clerk or young engineer to Washington to plead his case. He goes himself, with the best legal talent and engineering ability he can get. The bureau now proposes to send an inexperienced engineer to plead its case. It has even gone further. It is observed that experienced, trained, and highly competent men drawing salaries of $4,500 to $5,000 per year have been replaced by inexperienced men at a much lower salary; that these new men are now handling major tax cases, making adjustments in conferences where enormous sums are involved, and establishing precedents that have a far-reaching effect.

The administrative handicaps under which the engineer labors are often most discouraging. The salary is small; promotion slow; the superior official is frequently a political appointee, who has no engineering training; pressure from higher up is often brought to bear for the relief of some constituent of the administrative officials, and even Congressmen intercede for friends from the old "home town."

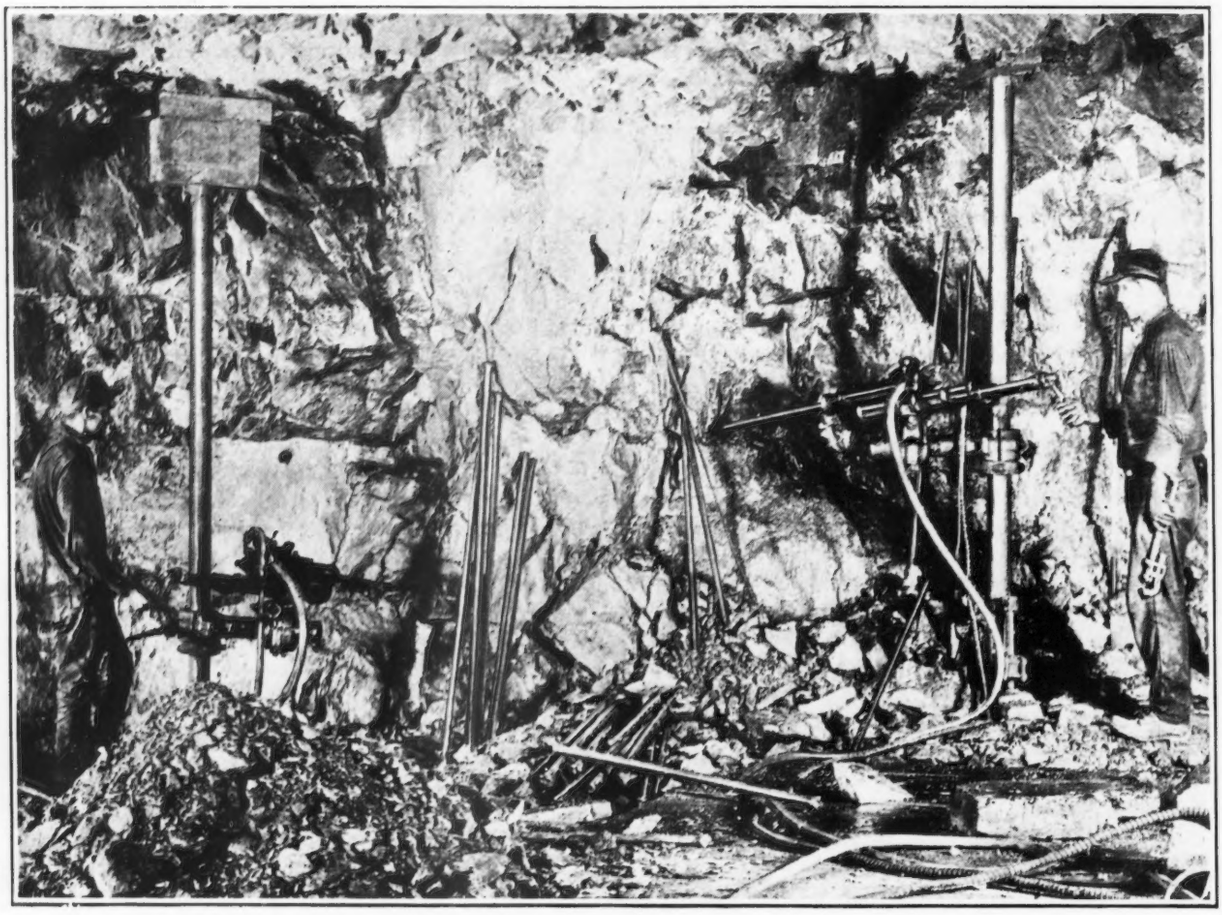
Though the young engineer may get a certain amount of experience, yet both he and the government are the losers. The engineer can't live on this amount in Washington, but he has hopes that at the end of two years he may be promoted to $225 a month. As a further inducement he is allowed the liberal sum of $4 per diem when on field duty to compensate for hotel expenses, meals, laundry, and other incidentals. With such a salary the temptation to yield to sinister influences is doubly strong. An engineer in the Bureau of Internal Revenue has no assurance of a five-year job, even under civil service appointment. If he does not satisfy the administrative officials, he is dismissed. Should he not please an influential taxpayer, there is a way of terminating the engineer's services. How can he serve two masters and maintain his self-respect and reputation? The government loses by reason of poor settlements and bad precedents established. It is not clear what philosophy is behind such appointments. The psychologic effect of it upon the employee is plain, and the demoralizing influence upon the personnel of any organization under such conditions is astounding.

## England and the Continent

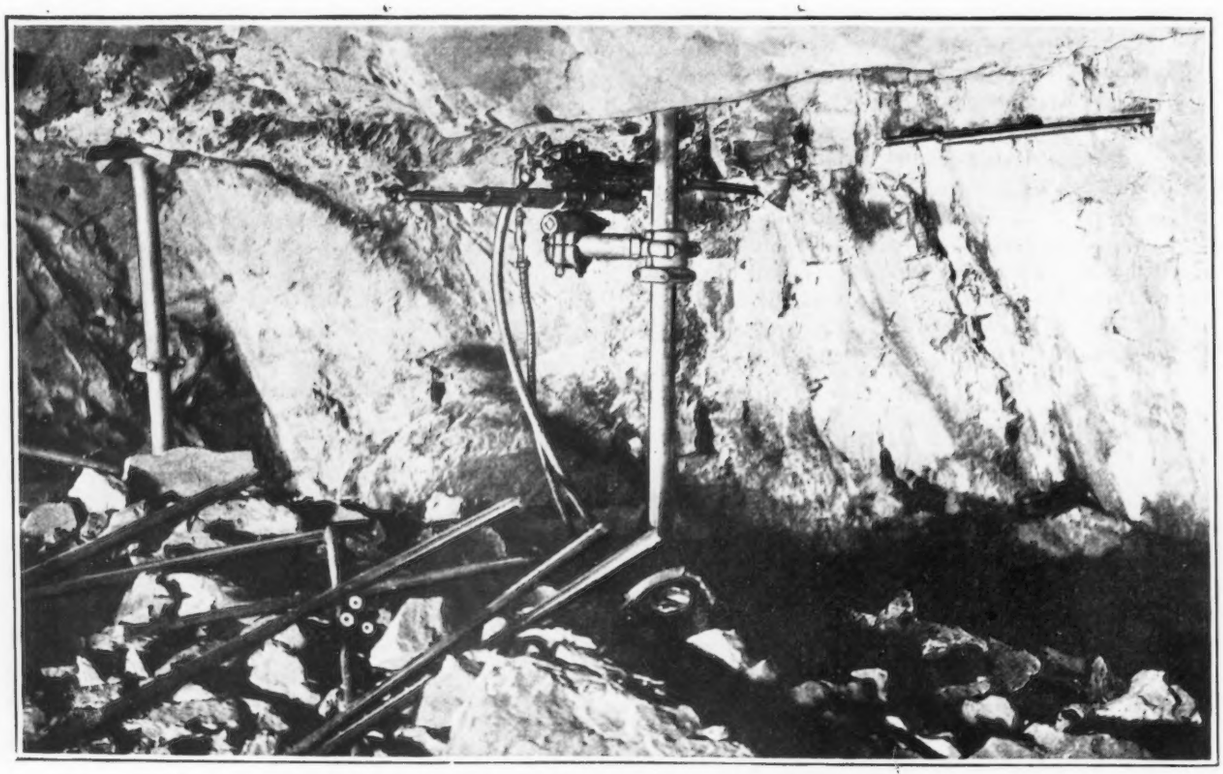
STERLING EXCHANGE has been practically at par for several months, but on May 15, owing to the covering of short accounts following the end of the general strike, the pound sterling was actually worth more than its gold-exchange value in United States dollars, for the first time since the outbreak of the World War. This event is worth chronicling as the crowning achievement in the effort to stabilize the British currency at its pre-war value and to maintain British credit. And in the same week the greatest industrial strike of all time reached a quick and "common-sense" ending without a shot being fired. Surely every one with any interest in international affairs at all must doff his hat to old John Bull.

The impressive example of British honor and steadfastness is made all the more impressive by contrast with conditions on the European Continent. French finances are going from bad to worse; the franc has dropped below 3c., and the very conditions that French-

## Stoping at United Verde



*Breast stoping in cut-and-fill stope at United Verde*



*Silling or taking out first cut for cut-and-fill stope*

# Drilling and Blasting Underground at United Verde Mine

*Details of Practice in Drifts and Crosscuts, Raises, Shafts and Stopes—Ground Is Classified, Permitting Fair Comparisons—Heat-Treating Machine for Tempering Steel—Other Equipment and Supplies—Wages and Unit Costs*

By C. E. Mills

Chief Engineer, United Verde Copper Co., Jerome, Ariz.

THE GROUND at the mine of the United Verde Copper Co., at Jerome, Ariz., varies widely, from soft easily breaking schist to hard massive iron sulphide and tough quartz porphyry. For this reason the cost of drilling and blasting varies widely throughout the mine.

The orebodies are of the schist-replacement type, and the typical contact orebody grades off into a hanging wall of hard massive pyrite and the footwall into barren schist or quartz porphyry. This condition permits cut-and-fill stoping methods. Occasional lenses in the massive sulphide have sufficiently strong walls to permit shrinkage methods. Schist stopes in blocky ground are mined by square-set methods, and vertical pillars between stopes and horizontal floor pillars by square-set or top-slice methods.

In 1925, development work included 10,147 ft. of drifts and crosscuts, 6,256 ft. of raises, and 1,007 ft. of sinking. Extraction of ore in 1925 totaled 924,221 dry tons, 53.5 per cent coming from horizontal cut-and-fill stopes, 14.5 per cent from square sets, 13.2 per cent from shrinkage stopes, 11.5 per cent from the glory-hole, and 7.3 per cent from top-slice methods.

The Ingersoll-Rand 248 is used for practically all drifting and stoping in medium or hard ground. Mounted jackhammers are occasionally used in soft schist. The Ingersoll-Rand R-72 will eventually replace the 248 in hard ground because of its greater drilling speed. The hand-rotated Ingersoll-Rand CCW-11 is used in driving raises and the Waugh 39 in hard iron raises. The Sullivan DP-33 jackhammer is used for plugging and the Waugh 37 for sinking. The Waugh 34 is used with 1¼-in. hollow-round sectional steel for drilling prospect holes up to 150 ft. in depth. The average repair cost on drills varies from $0.68 to $1.35 per machine shift, depending on type of drill and length of service.

## Speed of Drilling Varies Greatly

The drilling speed varies greatly in various classes of rock at the United Verde. With the same machine and in the same ground the drilling speed varies inversely as the volume of the hole drilled. Table I shows the difference in drilling speeds with a 248 machine at 90-lb. air pressure with different size bits.

**Table I—Drilling Speed with 248 Machine. Air Pressure 90 lb.**

| Ground | Average Drilling Speed in Inches per Minute, Gage of Bit 2½ In. | Gage of Bit 1⅝ In. | Per cent Increase |
|---|---|---|---|
| Massive sulphides | 3.3 | 5.2 | Plus 27 |
| Fresh porphyry | 5.5 | 7.9 | Plus 43 |

For this reason the size of the steel used in mining operations and the gage and gage changes of the bit are important factors in drilling efficiency. The drilling speeds of different ground classifications at this mine are given in Table II.

**Table II—Drilling Speed in Different Classes of Ground**

| Ground Classification | Approximate Drilling Speed, Inches per Minute |
|---|---|
| Very good | 18 |
| Good | 12 |
| Medium | 8 |
| Hard | 4 |

Two sizes of drill steel are used—namely, ⅞-in. quarter octagon for jackhammers and stopers and 1¼-in. hollow round for all Leyner-type machines. The double-taper cross bit with ⅛-in. gage reductions is standard for all steel. Table III gives the various lengths of steel used.

**Table III—Lengths of Steel Used**

| Machine | Starters: Gage, In. | Starters: Length, Ft. | Number Changes, In. | Finishers: Gage, In. | Finishers: Length, Ft. | Finishers: Length, In. |
|---|---|---|---|---|---|---|
| Pluggers | 1½ | 2½ | .. | 1¼ | 10 | 10 |
| Jackhammers and stopers | 1⅞ | 2½ | 10 | .. | .. | .. |
| Leyners | 1⅛ | 2½ | 10 | 1¼ | 10 | 10 |

## Heat-Treating Machines Used

Drill steel is forged at 1,950 deg. F. and tempered by means of Gilman CE-21 heat-treating machines at 1,500 deg. F. Shanks are forged at 2,100 deg. F. and hand-tempered at 1,800 deg. F. in Houghton No. 3 oil. Hardness of bit is maintained about 600, Brinell scale of hardness, and shanks at 370 Brinell. Forging furnaces will average 350 steels per shift and Gilman furnaces 800 per shift of eight hours. All furnaces are provided with thermocouples and indicating pyrometers. The total cost per steel sharpened is $0.13 and represents a cost of $0.052 per ton of ore broken. This does not include delivery to and from the mine. The bonus rate was formerly based on seventy pieces of steel per man-shift in the shop, but has since been changed to a rate based on machine shifts in the mine. The breakage averages 2 per cent on 1¼-in. hollow round and 5 per cent on ⅞-in. quarter octagon. At present the company is using Ingersoll-Rand Sandviken steel.

Three sizes of hose are used throughout the mine—namely, ½ in. for water, ¾ in. for pluggers and stopers, and 1 in. for all mounted drills. All sizes of hose are provided with a standard lugged coupling and spur which fits all types of machines and 1-in. pipe lines. This scheme is a decided advantage, as it allows any size hose to be used on any drill without changing connections.

All damaged hose is brought to the surface for repairs and mended by use of a repair machine developed and patented by a mechanic on the job. It is called the "McKee Hose Facilitator." It tests and cuts hose, inserts nipples, and wraps hose with wire, all by means

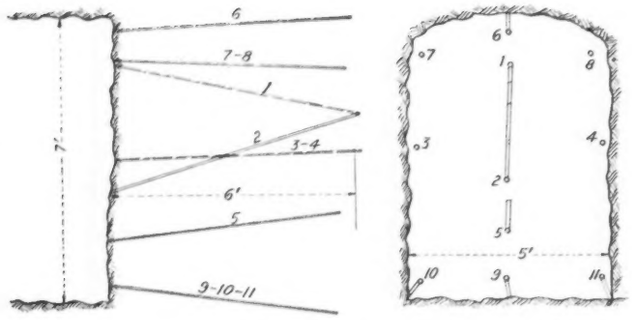



*Fig. 1—11-hole center V-cut drift round*

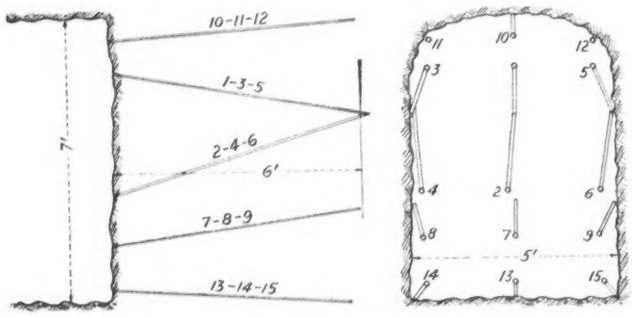



*Fig. 2—15-hole V-cut drift round*

of compressed air. A mechanical device is also provided for forming the wire loops for wrapping.

The average life and cost per 50-ft. hose for maintenance is given in Table IV.

**Table IV—Life of Hose and Maintenance Cost**

| Size Hose, In. | Life, Months | Monthly Maintenance |
|---|---|---|
| 1 | 9 | $1.60 |
| ¾ | 11 | 1.00 |
| ½ | 10 | .90 |

### Gelatin Dynamite Used Underground

Two varieties of explosive are used in underground operations. Fifty per cent gelatin dynamite is used in massive sulphides and tough porphyry, and 35 per cent gelatin in schist and moderate ground and for all plugging and bulldozing. All stick powder comes in red-colored wrappers. This is a safety measure to distinguish between stemming cartridges and explosives. It also aids in locating missed holes.

Explosives are stored in a 20x50-ft. magazine 3,000 ft. from the portal of the main haulage tunnel on the 1,000 level. Powder is delivered to No. 6 shaft in a powder car of special construction and distributed to the various levels on the graveyard shift, when interference with mining operations is negligible. Sufficient powder for two or three days' operations is stored in small magazines on each level. These magazines are situated conveniently with respect to the orebody and adjacent to the tool room to enable the powder man on each level to handle both tools and powder. This powder man issues powder and fuse to the miners and fills out a form showing working place and amount of powder and number and length of primers issued.

A smooth, black-finished, cotton-countered safety fuse "Dreadnought" is received in spools of 3,000 ft. and cut to proper lengths by a mechanical cutter which cuts eight pieces at a time and is operated by a small air cylinder. A cap crimper, operated by a hand lever, enables an operator to cap and crimp 600 fuse per hour. The primers are placed in wood-lined carbide can containers with hinged covers and delivered to the various powder magazines on each level. For plugging and stoping in soft ground 6-x caps are used with 35 per cent powder and 8-x caps elsewhere. Rubber sleeves are used on caps where water is met. Electric blasting is used in all sinking operations. Standard fuse lengths are 4 and 5 ft, for block-holing and 7 and 9 ft. for drifts, raises, and stoping.

### Drilling and Blasting in Drifts and Crosscuts

The following factors determine largely the type of round desirable and the explosive charge required:

1. Physical characteristics of the ground.
2. Size of drift or crosscut.
3. Depth of round.
4. Powder distribution.

1. The physical characteristics, hardness, fracture planes, bedding planes, and the like, determine largely the type of round and number of holes necessary to break the round. This can be learned only by experience.

2. The size of the drift determines the depth of a round to a large extent. The larger the opening, the more ground can be pulled with the initial cut.

3. The depth of round is determined by the character of the ground and also by sequence of operations. Unless one miner can work in two headings, it is desirable to have the round drilled and ready to blast at the end of the shift. If the drilling runs over into the next shift, time is lost.

4. Miners are apt to be wasteful of powder unless on contract basis. With a bonus system they prefer to overshoot the round, because if they lose footage they lose money. It is also usual to load the cuts with a given amount of powder and load slab holes with one or possibly two sticks less, whereas if the slab holes

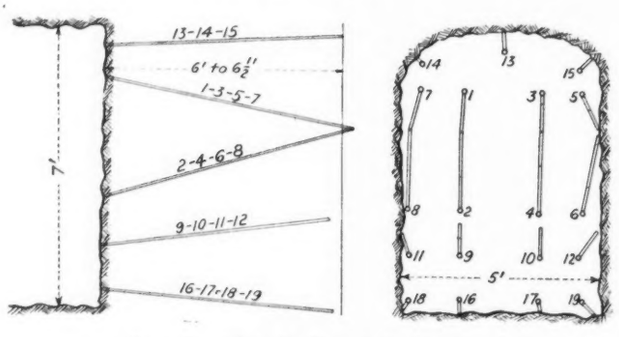



*Fig. 3—19-hole V-cut drift round*

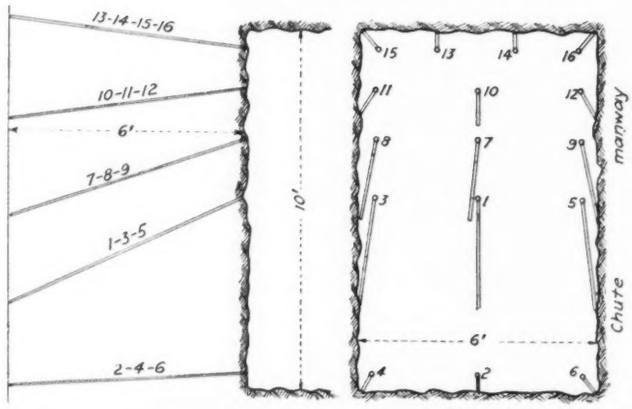



*Fig. 4—16-hole raise round*

are properly placed they should not require more than 65 per cent each of the amount of powder used in the cut holes.

Stemming or tamping is recognized as good practice, and actual tests have shown a 20 to 30 per cent saving in powder by the use of it. Although no penalty measures have been taken to enforce its use, stemming is used by most miners.

### Efforts Made to Save Powder

Various methods have been tried to increase the drilling efficiency and reduce powder consumption. The bonus department now posts the daily powder consumption in each working place, and all bosses are furnished with detail costs on all working places at the end of each month. This stimulates interest and competition between the different shift bosses, and they naturally exert more effort to reduce the powder used and check up on any excess labor costs. Table V gives the average cost of drilling and explosives for drifts in various classes of ground.

**Table V—Average Cost of Drilling and Explosives in Drifts**

| | Hard Iron | Fresh Porphyry | Schist and Soft Porphyry | Average All Drifts |
|---|---|---|---|---|
| Average drilling speed—inches per minute | 6 | 10 | 14 | ..... |
| Number of holes | 16 to 18 | 14 to 16 | 10 to 12 | ..... |
| Advance per round | 4 | 4½ | 5 | ..... |
| Powder, pound per foot of advance | 17.5 | 15.0 | 9.0 | 11.3 |
| Powder, cost per foot | $3.60 | $3.00 | $1.80 | $2.28 |
| Miners, cost per foot | 2.80 | 2.50 | 1.75 | 2.16 |
| Chuck tenders, cost per foot | .88 | .62 | .45 | .57 |

Other charges in connection with drilling are: Compressed air, $1.30 per foot of advance; drills, 0.40 per foot of advance; and drill steel, 1.10 per foot of advance. Powder cost includes powder, caps and fuse. Powder, 9c. per stick; caps, 1c. each; fuse, 0.6c. per foot. The miner's rate of wages is $4.95 per shift and that of the chuck tender is $4.40 per shift.

The most common rounds are the V-cut, toe cut, and upper cut. In any of these rounds the number of holes may vary from nine to ten up to as high as twenty-eight, depending on the ground to be broken. Actual comparisons show that the V-cut round will pull a larger footage with less powder than either the upper cut or toe cut rounds. Figs. 1, 2, and 3 show typical standard drift rounds used at this mine. The pyramid cut is occasionally used, but it is much easier for the miner to connect the cut holes in a V-cut than it is in a pyramid cut. Unless the cut holes are holed together or come within a few inches of each other at the bottom, they do not go together and the complete effect of the powder is lost. For this reason the V-cut round is preferable to the pyramid cut.

All drifts and crosscuts are carried on bonus, the rate being a certain number of feet per drill shift, depending on drilling speed and characteristics of ground, temperature, and local conditions. These rates vary from 0.5 to 3.8 ft. per machine shift.

### Raises Standard as to Size

Raises are, with few exceptions, standard as to size, being approximately 6x10 ft. in cross-section. Temporary manways are cribbed with 4x6 in. x 4 ft. 4 in. cribbing. Permanent manways and raises for development purposes are carried up with 5 in. x 8 in. x 5 ft. cribbing.

Because of the manway in one end of the raise only, the drilling and blasting is so regulated that all holes

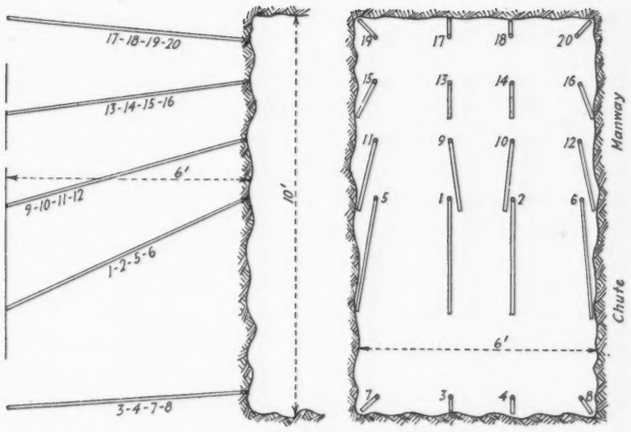



*Fig. 5—20-hole standard raise round*

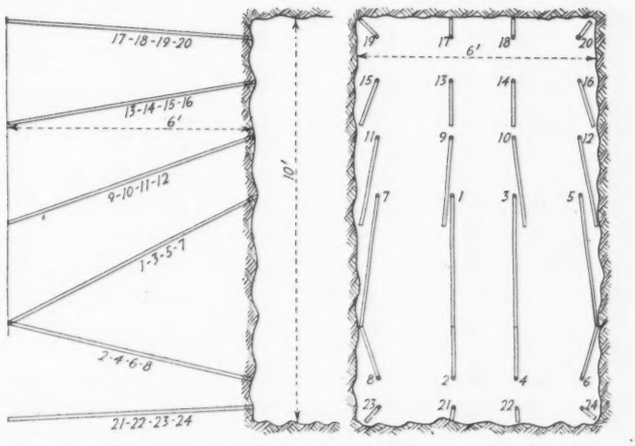



*Fig. 6—24-hole V-cut raise round*

are pointed to the chute side and away from the timber. This protects the manway cribbing and lessens the work of cleaning off the bulkhead after blasting.

Practically a standard round is used throughout the mine, consisting of from twelve to twenty-eight holes, one or two rows of holes being drilled on the chute side of the raise and from three to five rows on the manway side. The various raise rounds are shown in Figs. 4 to 6 inclusive. The number of holes and amount of powder can be determined only by actual experience with the ground, and the various factors which determine this are the same as have already been described under drifts.

Table VI gives average drilling and explosive costs in the three different classes of ground.

**Table VI—Average Drilling and Explosives Costs in Average 6x10-Ft. Raise Rounds**

| | Hard Iron | Fresh Porphyry | Schist and Medium Porphyry | Average All Raises |
|---|---|---|---|---|
| Drilling speed, inches per minute | 6 | 10 | 14 | ..... |
| Number of holes | 18 to 28 | 16 to 24 | 12 to 16 | ..... |
| Advance per round | 4 | 4½ | 4½ | ..... |
| Powder used, pound per foot advance | 17.1 | 15.8 | 13.7 | 14.6 |
| Powder cost per foot *a* | $3.50 | $3.20 | $2.80 | $2.96 |
| Miners cost per foot *b* | $11.00 | $10.10 | $7.50 | $9.06 |

*a* Powder at 9c. per stick, caps at 1c. each, fuse at 0.6c. per foot.
*b* Miners rate $4.95 per shift; includes labor on cribbed manway.

Other charges against drilling are: Compressed air, $1.30 per foot of advance; drills, 0.40 per foot of advance; and steel, $1.10 per foot of advance, the total being $2.80.

Raises are carried on bonus, and the base is a certain

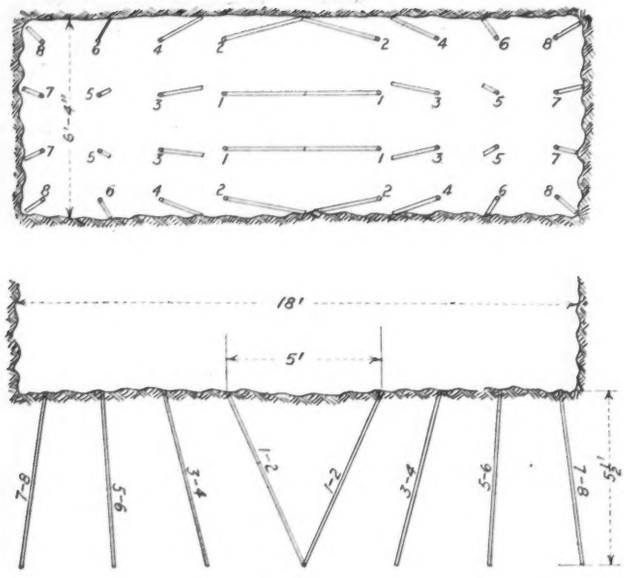



*Fig. 7—Standard shaft round*

number of feet per machine shift. This rate depends on drilling speed, character of ground, and local conditions and varies from 0.28 to 0.83 ft. per machine shift for cribbed raises and 1.00 to 3.33 ft. per machine shift for untimbered chute raises.

### Cost of Sinking No. 5 Shaft $52.70 per Foot

During 1925 No. 5 shaft was sunk from the 2,400 level to the 3,150 level at a total cost of $52.70 per foot. The shaft was 7x14 ft. in cross-section. The ground was a medium quartz porphyry. A V-cut round as shown in Fig. 7 was used and the cut placed to take advantage of the ground. Table VII shows the cost of explosives and miner labor.

**Table VII—Sinking Data, No. 5 Shaft**

| | |
|---|---|
| Drilling speed per minute, inches | 10 |
| Number of holes | 32 to 35 |
| Advance per round, feet | 4 5 |
| Powder used, sticks | 260 |
| Powder cost per foot | *a* $5.20 |
| Miners' labor, per foot | $31.85 |

*a* This cost does not include fuse nor primers. Electric delay detonators (1 to 10) were used and shot with a 440-volt A.C. current. The labor cost given includes timbering and mucking.

The bonus rate on this job varied from 0.17 ft. per miner-shift to 0.10 ft. per miner-shift at a depth of 600 ft. below the 2,400 level. The water encountered was not serious and amounted to 5,000 gal. per hour.

### Drilling and Blasting in Stopes

*Cut and Fill.*—Of all underground ore, 60.4 per cent comes from cut-and-fill stopes. The cut-and-fill method is used where walls are not sufficiently strong for shrinkage and where the back will support itself or may be held by timbered bulkheads. The method used is the typical cut-and-fill, the sill being started four floors or 22 ft. above the level. The cuts are taken 7 ft. in height, broken down on 2-in. flooring, and hand shoveled into cribbed chutes which are carried up through the fill.

Fig. 8 shows a typical fan-shaped round used in cut-and-fill stopes. Where two miners work in the same stope, they are served by a chuck tender who helps them set up, supplies drill steel, and removes the dull steel to the main gangway, where it is picked up by the steel nippers. Where one machine man works alone, a mucker or jigger boss helps him in setting up. The Ingersoll-Rand 248 mounted on 3-in. vertical column is used in all stoping.

### Miners Blast and Bar Down

The miners do their own blasting and barring down and are responsible for the safety of the back. The average stope round in untimbered stopes consists of from six to ten holes drilled to a depth of from 7 to 9 ft. They are spaced in two rows, breast and back holes, and are spaced to take advantage of the ground and break the ground uniformly. All block-holing is done on the floor and must pass a 11-in. grizzly opening. Boulders are shot at noon and at the end of the shift, and stope rounds at the end of shift only.

*Shrinkage Stopes.*—Of the mine tonnage, 14.8 per cent comes from shrinkage stopes. The drilling and blasting in these stopes is carried on in the same manner as in cut-and-fill stopes. The cost of the two operations varies but slightly from the costs in cut-and-fill stopes when based on ore broken and not on tonnage drawn from the stope.

*Square-Set Stopes.*—From square-set stopes comes 16.6 per cent of all mine tonnage. In these stopes the miner does his own timbering, and the labor cost is therefore much higher than in cut-and-fill stopes. Although the ground is easily drilled, it is necessary to use more holes and shoot carefully to avoid breaking the timbered sets. Square-set stoping is also used in removing floor pillars in coming up under the sills with cut-and-fill or shrinkage stopes.

*Top Slicing.*—The top-slicing method is used in a particular case where one of the large cut-and-fill stopes caved. Top slicing was selected as the best

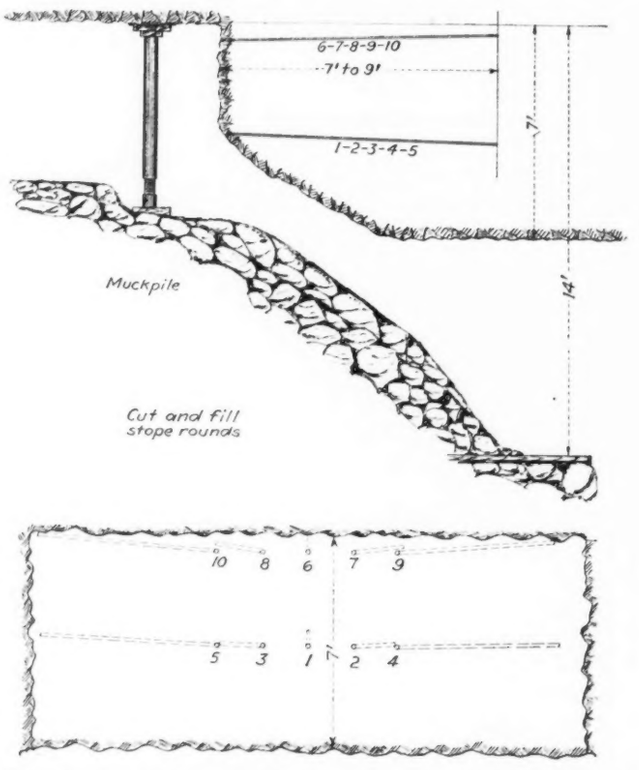



*Fig. 8—Cut and fill round showing even distribution of ground and powder*

method for removing the horizontal floor pillar. Cuts are taken at 11-ft. vertical lifts, the crosscuts first being driven at 25-ft. intervals from the main sub-drift in the foot and hanging walls. Mining is then started about midway between walls and the mat supported by 10-in. stulls spaced 5-ft. centers. These are blasted and the mat let down as operations retreat toward the wall drifts.

### Development Crosscuts Charged Against Stoping

Approximately 15 per cent of the ore is extracted by the parallel development crosscuts. This work is charged against stoping, and naturally increased the explosives and labor charge over other methods outlined above.

Table VI shows the comparison of the various mining methods used.

**Table VI—Average Costs of Drilling and Blasting in Methods Used**

| | Horizontal Cut and Fill | Square Set | Shrinkage | Top Slice |
|---|---|---|---|---|
| Per cent of ore from stopes | 60.4 | 16.6 | 14.8 | 8.2 |
| Miners per ton | $0.17 | $0.34 | $0.33*a* | $0.42 |
| Pluggers per ton | $0.07 | $0.14 | $0.17*a* | $0.06 |
| Explosives per ton | $0.12 | $0.09 | $0.22*a* | $0.16 |
| (30 per cent of explosives charge is for block-holing) | | | | |
| Tons per pound of powder | 1.6 | 2.2 | 1.7 | 0.9 |
| Tons per machine shift | 40 | 19 | 42 | 14.0 |
| *Bonus Rate* | | | | |
| Sets per machine shift | 0.6–2.0 | 0.4–1.4 | 0.6–2.0 | 0.5–1.5 |
| Tons per machine shift | 16–54 | 11–38 | 16–54 | 13–40 |

All extraction records are kept in sets. This unit is equivalent to the ground replaced by a square set of timber or 5½ x 5½ x 7 ft. Above costs are based on $4.95 for miners, $4.40 for pluggers, powder at 9c. per stick, fuse 60c. per 100 ft., and caps at 1c. each.

*a* These costs are based on ore drawn from stopes and not ground broken.

Additional charges for compressed air, drills and steel are as follows: Compressed air, $0.053 per ton of ore broken; drills, 0.046 per ton of ore broken; and steel, 0.136 per ton of ore broken; total, $0.235.

In breast stoping in cut-and-fill and in shrinkage stoping the powder charge is usually figured at one stick for each foot of hole. Nine sticks would therefore be the usual charge for a 9-ft. hole. With proper spacing of holes and the use of stemming it has been possible to reduce this powder consumption by approximately 20 per cent.

### All Labor Under Bonus System

Practically all labor underground is done under a bonus system. The standards set for any class of work, whether mucking, mining, or timbering, are based on what an average man should be able to do. Any saving over and above this base rate is divided equally between the company and the workman. The base rates for the various classifications are given in Table VII.

**Table VII—Base Rates Under Bonus System for Various Classes of Work**

| Ground Classification | Approximate Drilling Speed, Inches per Minute | Feet Advance per Shift: Raises: Cribbed Raise | Raises: Chute Raise | Drifts: 5 x 7 Ft. | Drifts: 6 x 8 Ft. | Sets per Shift: Stopes: Open | Stopes: Timbered |
|---|---|---|---|---|---|---|---|
| Very good | 18 | 0.83 | 3.33 | 3.85 | 3.23 | 2.0 | 1.43 |
| Good | 13 | 0.62 | 2.50 | 2.86 | 2.44 | 1.54 | 1.18 |
| Medium | 8 | 0.47 | 2.00 | 2.00 | 1.72 | 1.18 | 0.87 |
| Hard | 5 | 0.36 | 1.43 | 1.25 | 1.06 | 0.83 | 0.53 |
| Very hard | 2 | 0.28 | 1.11 | 0.67 | 0.57 | 0.59 | 0.44 |

An allowance on raise work is made for pulling chutes and also height of raise above sill.

## A Method of Separating and Estimating the Platinum Metals

Separation and estimation of the various rare metals in the platinum group is difficult, and the work of many otherwise reputable assay offices is erratic in this field. An article by L. Wöhler and L. Metz recently published in Germany (*Z. anorg. Chem.*, 1925, 149, 297 to 323) discusses the practice. It has been abstracted as follows in *British Chemical Abstracts:*

By distillation with acid permanganate or with chromic and sulphuric acids, osmium is separated from all metals except ruthenium, as the volatile tetroxide. Tellurium remains in the residue as the non-volatile telluric acid. Separation from ruthenium is effected by heating at 275 deg. in a current of nitrous gases. Oxidation to the volatile osmium tetroxide takes place more readily than in oxygen, because, in the latter, gas oxidation is hindered by the formation of the non-volatile dioxide. Tellurium is not volatile below 500 deg., or ruthenium below 600 deg. Volatilization of osmium is hindered by sulphur and sulphides, and a higher temperature is then requisite; separation is still quantitative. Osmium is determined in the nitrous distillate by reducing with Devarda's alloy and distilling with permanganate or chromic acid. In nitrous gases tellurium forms the monoxide as an unstable intermediate product. When heated in nitric oxide to 520 deg., osmium forms the dioxide, $OsO_2$.

Rhodium and iridium are separated by chloridizing with excess of sodium chloride at 650 deg., when the double salts $Na_2IrCl_6$ and $Na_2RhCl_6$ are obtained. These are separated by extracting with a mixture of equal volumes of acetone and ether, in which the iridium salt is soluble. Rhodium is also separated from iridium and ruthenium by fusing with more than 20 times its weight of bismuth. A rhodium-bismuth alloy is formed which is completely dissolved by hot 50 per cent nitric acid. When less bismuth is used a new crystalline *compound*, $RhBi_2$, is formed.

Ruthenium is separated from iridium and rhodium by fusing with sodium hydroxide at 550 deg. The greater part of the ruthenium is converted into sodium ruthenate, and the remainder into ruthenium dioxide, which is soluble in nitric acid. Iridium forms the dioxide and rhodium the sesquioxide, both of which are insoluble in nitric acid. Iridium is partially dissolved by molten potassium hydroxide and, to a greater extent, by potassium carbonate, on account of its higher melting point. Ruthenium is also separated from rhodium and iridium as the volatile tetroxide by distillation with sodium hydroxide solution and chlorine. If it is alloyed with iridium it is necessary first to convert it into the soluble ruthenate by repeated fusion, preferably with potassium hydroxide and potassium nitrate.

The platinum metals can therefore be separated as follows. Osmium is volatilized in nitrous gases, and platinum and palladium are extracted from the residue with *aqua regia*. From the solution platinum is precipitated with ammonium chloride. Rhodium is removed from the undissolved residue by fusion with bismuth, and the iridium and ruthenium are separated by fusion with sodium hydroxide or by distillation with alkali chloride. The order of removal of rhodium and ruthenium may be reversed.

# How to Make Lump Rock in a Limestone Mine

*Excessive Spalls Increase Equipment and Operating Cost—Slow-Acting Explosive Essential to Best Results—Overload Charges to Be Avoided—Arrangement of Drill Holes Important*

By Ralph W. Smith
Superintendent, Peerless White Lime Co., Ste. Genevieve, Mo.

AN ESSENTIAL REQUIREMENT in producing limestone for the manufacture of lime is that there should be a minimum of fines and a large percentage of lump. The methods of blasting in a limestone mine are therefore essentially different from most metal-mine practice. In most metal mines the ore must pass through one or more chutes before it reaches the surface, and these will hang up if there are large chunks in the pocket. Large chunks are also more difficult to handle if mechanical loaders are used. Furthermore, if the ore is well shattered by blasting, it reduces the duty on the crushing plant to which the ore usually goes. As a rule, a different condition exists at limestone mines.

A great many lime burners reject the spalls (material, in the practice under discussion, less than three or four inches in size or diameter) because expensive equipment is required (now in process of development) to treat them. Thus, spalls are often a source of expense. In open quarry work, black powder and various grades of dynamite give excellent results and a low spall percentage which are difficult to duplicate in an underground quarry. The tight shooting necessary to drive rooms, headings, or drifts necessitates a heavier explosive charge per ton of rock, which results in a larger proportion of spalls. A study of methods to reduce this percentage has been made in the mine of the Peerless White Lime Co., a subsidiary of the Hunkins Willis Lime & Cement Co., of St. Louis, Mo. In so doing it was found that the factors which effect the proportion of spalls are: (a) type and strength of explosive, (b) method of loading and shooting, (c) method of drilling, and (d) kind of stemming.

## Type of Explosive Most Important Factor

Thirty-five per cent gelatin dynamite was used at first because the fumes were not objectionable. Later it was found that 25 per cent gave better results, and then the mine followed the experience of the coal mines, some of which use large quantities of bulky, low-strength ammonia dynamites to increase the percentage of lump coal. Shipments of dynamite to the Peerless company now contain 25 per cent gelatin and a slow ammonia dynamite. The gelatin is used in wet holes and tight and heavy shooting. Sometimes when the burden is heavy a few sticks of gelatin are inserted in the toe and ammonia dynamite is used in the remainder. The ammonia dynamite produces more lump rock than the gelatin because its rate of explosion is slower and it therefore approaches more nearly to black powder. The approximate speed of these explosives is given by a technical representative of one of the large powder companies as:

| | Feet per Second |
|---|---|
| Black powder | 3,000 to 4,200 |
| Ammonia dynamite | 6,560 |
| Twenty-five per cent gelatin | 12,470 |

In using gelatin, considerable care must be exercised in properly loading the hole to produce a maximum of lump rock, because the margin of safe overload for good shooting is much smaller than in metal-mine shots. The accompanying "Blasting Overload Chart," Fig. 2, illustrates this condition. The effect of a slower dynamite is to extend the limits of loading within which it is possible to do good shooting. This also induces a condition which tends to waste some powder

*Fig. 1—Turbro stoper in drilling position for taking down roof at Peerless White Lime Co., Ste. Genevieve, Mo.*

by overloading, but the expense of ineffective powder is much less than the waste from increased spalls. Furthermore, this powder waste is probably more than offset by the saving of reloading holes. In the effort to make good rock with a faster dynamite it is not an uncommon practice to reduce the charge until the hole is underloaded, and this increases powder consumption rapidly. There are fewer holes which do not break with proper loading of the slow dynamite. The chart also illustrates the large possibility of underloading a hole charged with black powder. A different spacing of drill holes or a lighter burden would change this, but this and other characteristics of black powder do not seem desirable underground.

## Description of the Chart

The chart, Fig. 2, is merely an arbitrary and theoretical manner of illustrating why we get better results as far as spall percentage is concerned, from our

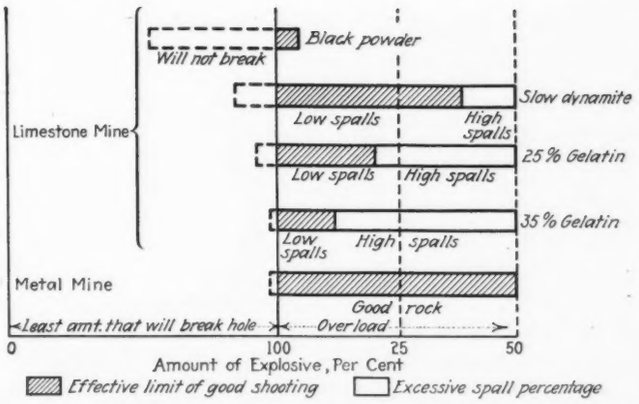



*Fig. 2—Chart showing approximate blasting overload*

"slow dynamite" than from other grades of dynamite; also a rough comparison with satisfactory blasting in the average metal mine. Since the chart is arbitrary and is based on observation instead of measured, scientific testing, it is labeled "Approximate."

If we start with zero powder at 0 per cent on the chart and gradually increase the powder charge in any hole until it is just enough to break the burden, we can properly designate that amount of powder as a 100 per cent charge for that hole. This amount will vary with every hole according to its burden, depth, and distribution of burden in addition to location: whether top, middle, or bottom. Each hole has a theoretical 100 per cent powder charge. Anything under this will result in the hole not breaking, or only partly breaking, and for this reason is marked in dotted lines. Thus, as we *recede* from a 100 per cent charge the powder becomes increasingly ineffective. The difference in the size of these dotted areas represents the relative danger of underloading with various types of explosive. Thus, with black powder the area is large because it is difficult to get enough black powder in the hole to break the burden. This area is much smaller with our most satisfactory explosive, the "slow dynamite," but even then is larger than with faster explosives. Although this area is quite small with the faster gelatins, this protection is expensive, as it is paid for by having a small area on the other side of the 100 per cent line which represents good blasting.

Any dynamite in addition to the theoretical 100 per cent is unnecessary, but the practical powder man must be able to establish within practical limits the charge which will break the hole and yet not be an overcharge. His measurements of the hole may be exact and his judgment of the charge may be quite accurate if there were no other variables; but there is one variable that cannot be exactly measured or estimated—namely, planes of weakness, such as jointing or bedding planes. These often exert a considerable influence on the effect of the explosion and the proper amount of charge. If the hole is loaded with a fast dynamite, an unseen plane of weakness may alter the estimated 100 per cent so much that it will be found after the blast that the hole was considerably overloaded. The waste of powder is the least factor in this case. It is the waste of limestone in spalls and loading cost of getting them out of the way that is important in the work here considered.

The cross hatching extends about to a 10 per cent overload for 35 per cent gelatin, to 20 per cent for 25 per cent gelatin, and perhaps to 40 per cent for slow dynamite. In other words, it is more difficult to overload a hole with the slow dynamite. It is also practically impossible to overload a hole with black powder; but, at the same time, it is almost impossible to get enough charge in the hole to bring it out. Thus the cross hatching represents the "effective limit of good shooting" because a powder within those limits *for that particular hole* will produce *low spall percentage.*

The white areas beyond the cross hatching indicate overcharge so great that a *high spall percentage* results. The portion of the chart from 0 to 100 per cent powder is of a different scale than beyond 100 per cent. This was done to exaggerate the limits within which *effective shooting* could be done by the various types of powder. It is somewhat like putting a magnifying glass on that part of the scale, and I took that liberty because the chart is only approximate and not based on actual measurements.

The portion marked "Metal Mine" shows that "good rock" can be produced anywhere from a 100 per cent charge to a 50 per cent overload. The explanation of this is that the material does not become waste because of its size after the blast. According to the chart, the powder man should try to attain that perfection which would enable him to load each charge at about 105 per cent. This would give maximum results with regard to spall percentage, with the least waste of powder. Our powder men probably approach an average of between 105 to 110 per cent, over-all results.

A helpful device for improving the blasting is the "Shot Record," which is used to establish standard loads for various lengths and burdens of holes, and for checking results. If the management could always secure a powder man who is competent to make burden calculations on holes, a very high class of blasting with minimum powder would be assured. However, men of this ability are not usually available for this type of work. Ammonia dynamite partly solves this problem by making it more difficult for the average powder man to overload to the point of shattering the rock.

### Arrangement of Drill Holes

Ammonia dynamite has the disadvantage of insufficient strength for some holes, especially in the toe. A common practice in the Peerless mine is to drill as many as nine rows of horizontal 18-ft. holes, one row behind the other, and if these holes leave a foot or so on each row as they are blasted in sequence, not over half the hole would be available for shooting by the time the sixth row was reached. This possibility is prevented by using one or two sticks of gelatin tamped well down into the toe of the heavier holes. Air spacing of slow dynamite is used on the lighter holes to prevent throw-

**Shot Record**

Heading Holes — Date.....

| Location | Length, Feet | Burden: Toe, Feet | Burden: Collar, Feet | 25 Per Cent Gelatin: Sticks, | 25 Per Cent Gelatin: Length, Inches | Other Powder (Kind ( )): Sticks, Number | Other Powder (Kind ( )): Length, Feet | Bags Tamp Size (1¼x16) Inches | How Fired | Results |
|---|---|---|---|---|---|---|---|---|---|---|
| No. 4 top.. | 15 | 4 | 2 | 2 | 12 | 8 | 5 | 6 | Bat | Good |
| No. 1 Mid | 18 | 3½ | 3 | 2 | 12 | 7 | 4 | 5 | Bat | Excellent — Left collar |
| No. 6 Top | 18 | 3½ | 2 | .. | .. | 6 | 4 | 5 | Bat | Good } Fired together |
| No. 6 Bot | 18 | 3½ | 1 | .. | .. | 9 | 6 | 5 | Bat | Too heavy } |

ing of the rock; sometimes the sticks are pushed in till they touch but not tamped to fill the hole; sometimes they are left with three or four inches of air space between each stick.

### Moist Stemming Gives Best Results

One of the most important means of securing uniform results and low powder consumption is to use plenty of stemming and keep it uniform. The best results at the Peerless mine are obtained with a mixture of about two-thirds damp red clay and one-third pulverized limestone. The spalls gradually increased during one of the summer months, and after much inquiry and search for the reason it was found that the clay for stemming had dried out. The quality of blasting became normal as soon as the clay was moistened before mixing with the rock dust. This mixture is kept at a consistency that will form balls when squeezed in the hand. It is not uncommon after a blast to find holes in which a short portion of the collar is filled with this mixture and compressed by the blast until it is as hard as the surrounding rock.

### Blasts Fired While Men Are in Mine

Blasting is done while the entire mine crew is at work, because the number of headings is limited by a property line and all available tracks must be used to keep up the production. During the last year the workings have begun to spread out into a new tract of ground, which is giving many additional tracks, and it may be possible to arrange a better blasting program during 1926. Electric caps are used entirely in the headings, as this reduces lost time to a minimum where shooting is done during hours when the entire crew is at work.

Extreme safety precautions are necessary when blasting is done during regular working hours. The Peerless procedure is: The powder man and helper load the hole to be shot. The powder man then blows a signal on a loud air whistle centrally located near the headings. This warns the men of the coming blast and informs them in which heading the blast will be. As soon as the men are safely in the clear protected by pillars, he gives two short toots with the whistle. This is the signal for the assistant to fire. The assistant, who has been waiting at the spot where the blast is to be, hears this signal and ignites a small amount of red-fire powder to burn near the hole for one-half minute and retires to a point of safety. Here he connects his wires to the battery and fires the shot. The entire operation requires about one minute if there is no unusual delay.

Fig. 3 shows order of firing shots in such a way that the broken rock does not add to the burden on the explosive. Hole No. 1 is fired, throwing the broken rock on the floor in front of Hole No. 2. No. 2 is then fired, adding to the pile of broken rock in front of No. 3. After No. 5 is fired the broken rock is piled up so tight against the face that it must be removed before firing No. 6.

### Red Flare An Effective Safety Measure

The red-flare powder was adopted after a minor accident which might have been serious. A few small rocks were thrown into a group of men who thought they were in the clear. These men were also seen by the head powder man, who thought they were not in the line of the blast. Had the red flare been set for the blast, the men would have seen that they were not safe and retired to another side of the pillar. The red flare has been effective a number of times since its adoption and has helped maintain speed of production with increased safety.

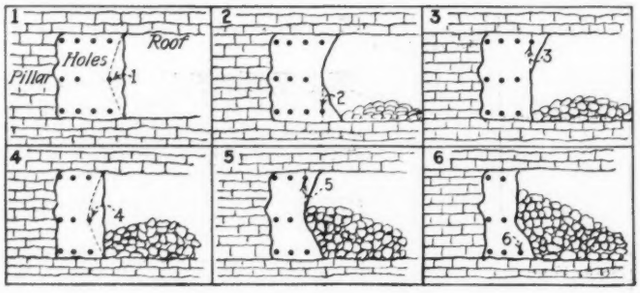



*Fig. 3—Diagram showing order of firing in a heading where an entire face is drilled and a large pile of rock is desired*

Note: No holes are fired against a rock pile as is the condition at hole No. 6.

## Belgian Congo Leads in Production of Cobalt and Radium

According to a recent report on the Belgian Congo in the *Mining Journal* (London), the colony can claim first place in production of cobalt and radium, third place in the production of copper and diamonds, and will before long occupy a prominent position in the production of gold and tin. The following figures are given to show the mining production in 1925, in metric tons: Copper, 90,000; tin, 1,500; cobalt, 300. Gold production amounted to 3,800 kg.; diamonds, 98,000 carats; radium, 20 grams. This production represents a total value of 820,000,000 francs. The traffic on the Katanga Railway has risen from 1,000,000 metric tons in 1921 to 3,000,000 in 1925.

The Antwerp diamond industry is kept going by the Forminière undertaking. Developments now being carried out include the erection of reverberatory furnaces with a capacity of 30,000 to 40,000 metric tons of copper per annum; a leaching works with a similar capacity; an increase of 30,000 kw. in the power station; and an installation for the production of 800 metric tons of powdered coal per day.

The electrolytic copper refinery in erection at Oolen (Belgium) by the Société Générale Métallurgique de Hoboken, in conjunction with the Union Minière, will have a capacity of 80,000 metric tons per annum. Works have been erected and are already in operation in the Kilo-Moto gold deposits, with a view to the crushing of 1,000 metric tons of ore per month. Cyanide works are to be started next year on the Nizi gold reefs, and will be capable of treating 200 metric tons of ore per day. It is hoped that in a few years the production of the Kilo-Moto mines will be raised to 125,000 oz. per annum, worth, at the current exchange, 60,000,000 francs.

Owing to the increasing employment of machinery, the number of workers employed does not increase in proportion to the production; in 1925 the production of copper was 90,000 metric tons and the number of natives employed totaled 14,000, compared with 30,000 metric tons of copper and 12,000 natives in 1921.

# Genesis of Chilean Nitrate

*Evidence Presented to Prove Derivation From Volcanic Tuffs and Mud—Occurrences Often Far Removed From Eruptive Centers—Leached From Tuff and Deposited in Arid Regions*

By James E. Harding
84 Wall St., New Haven, Conn.

WITH THE EXCEPTION of small amounts of sodium nitrate produced from guano, or synthetically by electrochemical methods, the entire amount of crude nitrate used in the arts and industries of the world for the last half century has come from a narrow stretch of barren desert in Chile. Crude bromine and iodine are produced with the nitrate. Thus in the three important articles of commerce, sodium nitrate, bromine, and iodine, Chile possesses a natural monopoly, which unless physical chemistry discovers the secret of cheap synthetic manufacture, bids fair to be maintained for a long time, because as yet nowhere else in the known world have there been discovered any other natural and workable deposits.

There are many other desert regions on the globe similar to the desert of Atacama, Chile, but that desert alone seems to possess in great volume the anomalous deposits of sodium nitrate to account for the existence of which geologists and chemists have long sought an explanation. Many ingenious theories have been advanced from time to time, and of these some have obtained wide credence among the workers on the nitrate pampa, the term which is used to designate all the nitrate-bearing terrain.

## Various Theories as to Origin

Dr. B. L. Miller[1] gives an admirable summary and bibliography of these various theories. In 1867, Dr. C. N. Noellner advanced the theory that originally the nitrate resulted from the decomposition of huge piles of seaweed, massed on this pampa, when it was a low-lying beach, that the land was uplifted and the sea water evaporated, leaving the sodium chloride to form a chemical compound of some sort with the nitrate produced by the decaying seaweed. As a proof of his theory he pointed to the fact that iodine was always found in conjunction with the nitrate so produced.

Previously, C. G. Hilliger, in 1869, propounded the theory that the nitrates were derived from great quantities of guano, deposited along the beaches of an inland saline sea. His theory was founded on the equation that the nitrogen contained in the guano, plus sodium chloride of the sea water, equaled sodium nitrate, and he pointed out, as a proof, that bird skeletons were occasionally found on the pampa.

In 1885, A. Muntz, from a study of Pasteur's then recent discovery of the effects of nitrifying bacteria, brought forth the theory that these deposits had been produced in some way from bacterial origin.

In 1887, C. Oeschnius propounded the theory that this nitrate was brought by the wind from Guano islands in the Pacific. In 1903 he retreated from that view to the extent that he claimed only a minute part of the nitrate was brought by the winds, thereby exciting nitrification in the air near where the deposits are now found, and that the heavier phosphates that were contained in the original guano were thus left behind.

In 1903, Semper and Michels propounded the theory that the nitrates were fixed by the electrostatic tension of the atmosphere, and pointed out that such tension always existed from the friction of the winds sweeping over the barren desert wastes, as is proven by the bad behavior of the telephone on foggy evenings.

In 1910, R. A. F. Penrose, after studying the deposits, thought that the pampa was formerly an ocean bottom, and later an interior basin occupied by a long salt lake, and that guano deposits were the source of the nitrate.

In 1896, Dr. William Newton ascribed the genesis of the nitrate to nitrifying action of bacteria on ancient vegetable matter contained in the soil and collected and deposited by drainage waters. That theory was favored also by A. Plagemann in 1897; by G. E. Bailey, writing on California deposits, in 1902; and by F. W. Clark, in 1908.

The above synopsis of theories is taken from Dr. Miller, previously cited. He adds that possibly the nitrate has been fixed by electric storms in the Andes and that possibly it has been brought to its present location by ground waters. He points out that at some places it is found close to the water level of the pampa and in others in small islands surrounded by a salt lake. He ascribes its position on the islands above water level to the fact that the nitrate seemingly has migrated upward from the water by some sort of effloresence.

I wish to state that no one has higher admiration for the attainment of Dr. Miller than I have, and that this article is not intended to reflect on his conclusion in any way whatever. He very clearly states that the theories outlined above may not be given credence. For my own part, I would add that they fall far short in every way.

## Not of Sea Origin

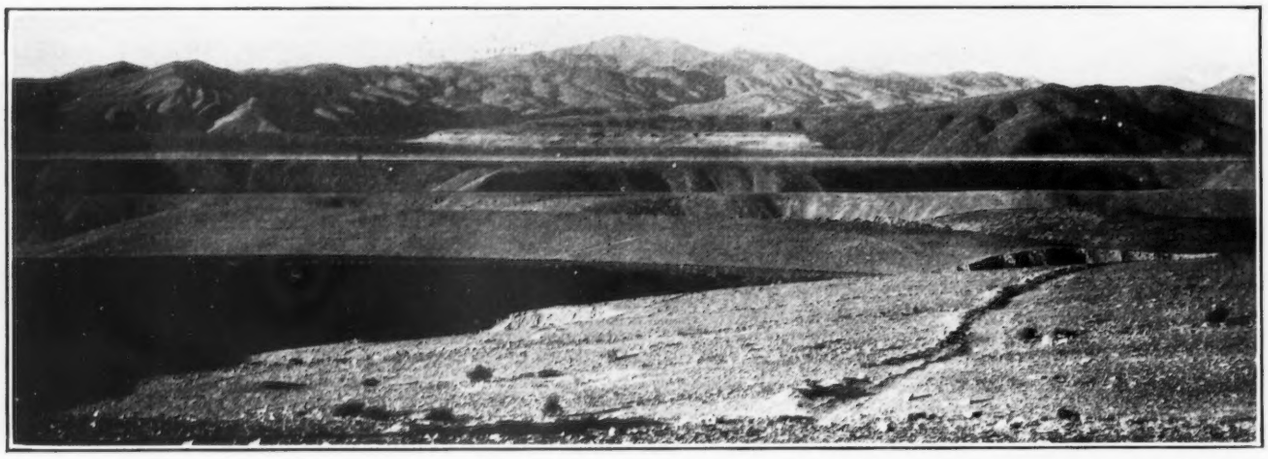
Any theory which is predicated on sea or guano origin fails completely. This region was a high gravel peneplain previous to the deposition of the nitrate. It has not been within 70 kilometers of the sea, nor less than 500 meters above sea level, since peneplanation. The deposits lie out on plains, in hanging valleys, and on the tops of hills where no conceivable flowage of water could have placed them. It is true that in some cases ground water is at present depositing nitrate, as at Aguas Blancas and other places, and also that by efflorescence wet plant tailings often are covered by a fairly thick deposit of nitrate; but I submit that no flowage of water could place a deposit of nitrate on the top of an isolated rounded steep-sloped hill, 200 meters high, where a workable deposit was found on the Tal Tal pampa.

The idea is also generally prevalent that the deposits occur in scattered patches with no connection from one to another, which conception is entirely erroneous. Actually, the case is that from Pueblo Hundido, about

[1] *Economic Geology*, Vol. XI, pp. 103-112.

150 kilometers south of the workable deposits, nearly to Tacna, a distance of about 1,000 kilometers, the entire longitudinal, gravel-filled syncline contains nitrate in greater or less degree. It is merely the scattered local concentrations which are rich enough to make workable deposits.

The concentrations just referred to occur under extremely varied conditions. At least one is on the top of a rather steep isolated hill; there are occurrences at the bottom or near the bottom of steep drainage slopes; other deposits have been found on islands in salt lakes slightly above water level, and still others occur on plains far from hills and far both vertically and horizontally from water. It may truly be said that the deposits have no general mode of occurrence as regards relation to surface contour, topography, hills and slopes, or ground-water level.



*Remnant of salitre tuff, resting on gravel plain in Cordillera. Note deep dissection of plain by gulches. No visible nitrate present*

In comparison to the general area, the deposits occupy an infinitesimal part, but they have been concentrated in such places as a clay-bottomed basin or not far from bedrock. Also, the nitrate is always encountered admixed with other saline material, such as sodium chloride, anhydrite, gypsum, magnesium chloride, and potassium compounds, as well as bromine and iodine. In no case, I believe, has a deposit been found superimposed on deep porous gravel.

In case any deposit of these mixed salts was subjected to rain or snow, the nitrate would be the first salt to be completely removed by solution. In case a saturated water solution of sodium chloride were to come in contact with a nitrate, the latter would be taken into solution and more or less of the sodium chloride precipitated. Thus it is clearly understood that where there has been precipitation to any great extent, sodium nitrate in quantity cannot exist.

For that reason we see the southernmost deposits of the Tal Tal pampa fading out into the lower-grade pampa for 150 kilometers toward Pueblo Hundido, where there are only low-grade nitrate deposits.

At the point where the railroad leaves the valley in which Pueblo Hundido is located, and attains the level of the higher-lying pampa, there is a deep cut, through the gravel in which there are thick bands of anhydrite with a very small amount of sodium chloride and no nitrate. Similar bands of anhydrite are encountered in the nitrate workings, but containing much more salt as well as some nitrate. Thus we see that to the south of the deposits of workable nitrate the water-insoluble anhydrite persists, the more easily water-soluble sodium chloride is nearly gone, and the nitrate is completely gone. That is of course assuming that similar mixtures of salts once existed at the several places, which the existing evidence proves.

Studying the amount of erosion which has gone on since the gravels were deposited, we see that across the Tal Tal pampa, where workable deposits exist, the main drainage course has not been lowered. The Pan de Azucar gulch crosses the longitudinal valley about 75 kilometers to the south of the Tal Tal pampa, and there erosion has somewhat lowered the surface, from 25 to 50 meters. The Pueblo Hundido valley, 55 kilometers to the south, has been lowered from 50 to 100 meters. The amount of erosion certainly has been in proportion to the amount of precipitation, since all the gulches lie on very nearly the same gradient. Therefore, we see that to the south the amount of nitrate now exists in inverse ratio to the amount of precipitation which has gone on since the gravels were deposited. This must not be lost sight of, because it will be again referred to.

To understand the genesis of these nitrate deposits, one must delve into the geological past of the region. In a previous article,[2] with reference to saline deposits in the high Andes, I mentioned the great tuff and volcanic-mud extrusions which have produced great areas of salt and gypsum deposits. The region had experienced a long period of geological calm and glacial climate, during which all depressions had been filled up by gravel floods to a great thickness and leveled off in great flat plains, when numerous volcanoes along the Cordilleran chain exploded, hurling tremendous volumes of tuff high in the air, to settle as a thick blanket over the entire then existing land area, from the Bolivian highlands to the south of Chile. Existing remnants suggest that the thickness of the tuff deposit was from 100 to 300 meters. As an end phase of the tuff eruption, great mud flows welled up from the craters and ran down on the plains and from such mud flows we find in the Cordillera today enormous deposits of salt and gypsum.

The proofs of the wide-spread tuff deposition are many. Remnants still exist throughout the Cordillera and also on the nitrate pampa. This is especially true of the Toco region, lying to the north and east of Antofa-

[2]Andean Salares, *Engineering and Mining Journal-Press*, May 15, 1926.

gasta. An earlier and thinner tuff deposit is visible along the wall of the Pueblo Hundido valley from Cortadera to Pueblo Hundido, a distance of seventy kilometers, and thins out only five meters in that distance. All the remnant surface deposits, of the much thicker and later tuff, carry nodules of flint and chalcedony as well as rough fragments of chert, ripped from the crater walls at the time of the explosion. Such nodules and fragments are found scattered all over the pampa, some in such position that they could not have been delivered by flowage. Some of these must have traveled through the air for a distance seventy-five kilometers from their original source to their present location, which testifies to the violence of the original explosion which started them on their way.

In the vicinity of the tuff remnants or the salares in the Cordillera we do not find nitrate deposits, nor would we expect to, on account of the much greater precipitation than there is in the vicinity of Pueblo Hundido, where also the nitrate has disappeared. In spite of the fact that commercial deposits are not found, nitrate still lingers in the tuff deposits, as is proven by the water which leaches through them. All analyses of water samples show nitrate in greater or less degree, if the water has its source in the region of the remnants of the tuff.

A typical analysis of such water is as follows: $NaNO_3$, 67 parts per million; NaCl, 3,415; $MgCl_2$, 338; $CaCl_2$, 432; $CaSO_4$-2H2O, 1,585; $CaCO_3$, 225; total 6,082.

The above analysis shows the content of sodium nitrate. The nitrate could not have come from decaying vegetable matter, since there is no vegetation to furnish it. A very striking feature of the analysis given is that not only does it show sodium nitrate content, but also the same salts which are found associated with nitrate on the pampa where it is mined. Even within the breached craters, whence came the extrusions of tuff, salt, and gypsum, we still find salt and gypsum in abundance.

The links in the chain of evidence are now fairly complete. We can prove the existence of the sodium nitrate in the water analysis from the tuff, and from that in the tuff itself. We trace all the salts back to the tuff and mud flows and then back to the volcanoes whence they came.

We cannot expect to find deposits of nitrate in the vicinity of the volcanoes, because that region has been subjected to much precipitation since the tuff extrusion. Neither do we find it in the lowlands, where there has been much less precipitation. We find it only where there has been very little precipitation, from the Tal Tal pampa to the north, where there has been so little rain that no erosion has been caused. The nightly fogs and dews to which have been ascribed such effects in concentration are completely inadequate, since their moisture never penetrates more than a centimeter from the surface. Nitrogen we know is a concomitant of all volcanic activity. How it became fixed in this case as sodium nitrate is a problem yet to be solved.

Once given the ubiquitous deposition of nitrate-bearing tuff, the location of the deposits is simply a problem in local concentration. We find them anywhere, such as on the top of a high hill, in a rock-bottomed basin, at the foot of a steep rocky slope, in gravel where bedrock is close to the surface, as a little hillock surrounded by salt lake, or in a clay-bottomed drainage basin from surrounding hills; or, in fact, at any place where water was prevented from going deep into the ground by an impervious medium and was obliged to flow out on surface where it could be desiccated.

It is not to be understood that the blanket of tuff was carried away by erosion, with complete absence of rain. Occasional light rains occur on the desert at present, and the geological evidence proves that, in the recent past, rains were more frequent than they have been since the region was known to man. In the present erosion of the tuff remnants wind is playing a far more important part than water, which is seen in the three views shown. There the surface of the low, flat-topped remnant is protected by a thin shell of hard anhydrite, below and under which the wind carves away the tuff to a nearly vertical face. Under such conditions, the very small amount of precipitation has assisted in dissolving soluble salts from the entire mass, either to leave them near by when desiccation takes place on surface, or to carry them away in case the run-off stays underground. Clearly, if the downward percolating water has happened to come to the surface from bedrock, or flows along the surface of a nearly impervious clay stratum, ideal conditions for desiccation are furnished, with the corresponding concentrations of salts taking place.

Once in solution, nitrate will stay until a very high point of saturation is reached, and if there is a general run-off from surface all nitrate will disappear. Where the tuff was deposited and where we had no run-off or very little run-off, we have nitrate deposits. Even the very slight difference in run-off between Pueblo Hundido and Catalina, a distance of 150 kilometers, has made the difference between valuable and worthless deposits. The balance is a very delicate one. Even from the locations where nitrate is now worked, tremendous quantities must have been carried away in solution, and we probably now have less than one-half of 1 per cent of the original quantity, although there are left several hundreds of millions of tons.

Rain falls on this pampa at intervals of about ten years. In the past it rained oftener, but the remnants of the deposits were preserved. At present the cycle is tending to increase aridity, and the future supply of

*Left. Basin deposit of nitrate, 25 per cent grade, mined, piled, and ready to be shipped. Right. Steep erosion face of a typical salitre tuff remnant*

# Making Sponge Iron in Australia

*Experimental Work in Connection with Metallic Contact Process of Ore Treatment Indicates Desirability of Using a Down-draft Gas Producer of Special Design—High-grade Product Is Not Necessary*

By P. M. Bonnerup

Presidential address delivered before the Chemical Society of Western Australia, Session of 1925-1926.

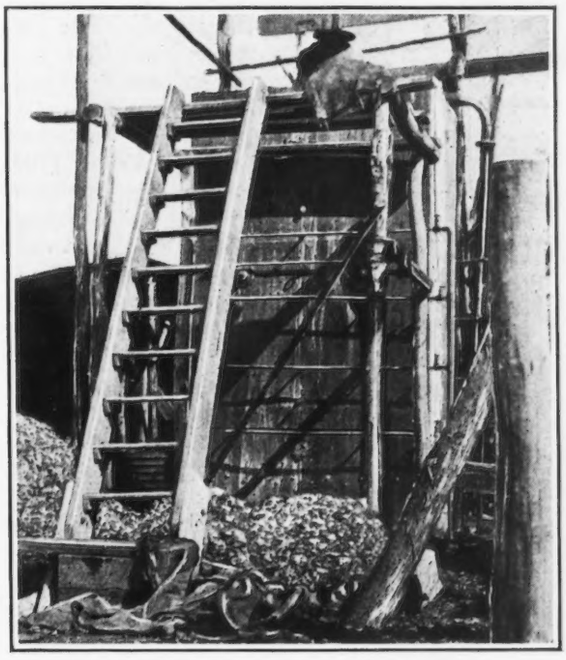
ATTENTION may reasonably be directed to the interesting and to some extent important work that has been done by Copper Separation, Ltd., at Ravensthorpe, Western Australia, in connection with the manufacture of sponge iron. This company is associated with The Australian Minerals Recovery Co., Ltd., in the development of the metallic contact process which was described as the Nevill-Soanes process in the *Engineering and Mining Journal-Press* of Aug. 4, 1923, page 195. The basis of the metallic contact process in its simplest form is the reaction in an ore pulp between oxidized copper minerals, a small proportion of ferrous sulphate or chloride, and sponge iron, a reaction that is enormously accelerated at a temperature of 70 deg. C. or over. Without speculating as to the nature of the reaction, it can be said that there is a vigorous action, which results in most of the oxidized copper minerals being decomposed and converted into cement copper, which is subsequently separated from the pulp by flotation.

The process necessarily requires the use of sponge or other finely divided iron, which should be comparatively low in cost, but which need not be high grade. Although technical literature, particularly that dealing with metallurgy in a general way, gives the impression that the manufacture of sponge iron is a comparatively simple matter, yet in actual fact this is not so. There is no doubt, however, that sponge iron has been manufactured in clay pots by the Chinese. Reference has also been made to the subject by a number of American operators, particularly by Messrs. Thornhill and Anderson, associated with the Chino Copper Co., of New Mexico. Messrs. Thornhill and Anderson have been successful in developing a furnace capable of producing sponge iron, but at the time that Copper Separation, Ltd., communicated with them, it was apparent that their work had hardly reached a stage when much assistance could be looked for as regards exploitation outside the United States. It also seemed probable that the furnace developed by Thornhill and Anderson could not, under Copper Separation, Ltd.'s, peculiar conditions, produce sponge iron economically. It is possible that this view is erroneous. The conclusion was based mainly on the large amount of heat required to be transmitted through carborundum tubes and then radiated on to the reacting material. It was therefore necessary to seek a solution of the sponge-iron problem when working under Australian conditions.

The work done comes under three headings, which were carried out progressively in the following order.

1. Pot method.
2. Externally heated rotating cylinder.
3. Producer method or modified blast-furnace process.

The pot method represents an attempt to develop the old Chinese method on a larger scale. The pots used were made of low-carbon cast steel 1½ in. thick, and were 36 in. high and tapered, having a maximum diameter of 18 in. They were capable of holding from 400 to 500 lb. of charge. The pots were provided with a lid resting on the top, there being contact surfaces machined so as to give substantially airtight conditions. In a typical test the pots were charged with a mixture of 100 parts of ironstone (56 per cent Fe) and 30 parts of charcoal, both of these materials being from ½ to 1 in. in diameter. After covering with the lid, the pots were heated for three hours in a reverberatory furnace at a temperature of about 900 deg. C. They were then removed and allowed to cool. The product contained 38 per cent of metallic iron. Although the pot method may possibly be capable of economical operation under favorable conditions, it was evident that under the local circumstances it was not the basis of a satisfactory process. The large amount of fuel needed, the difficulty of maintaining the required temperature with wood fuel (the only kind available), and the rapid rate at which the pots scaled, all resulted in unduly increasing the cost of production. Where suitable and cheap fuel is available, and where, by reason of cheap labor, the cost of handling the pots is not excessive, it is possible that something can be made of the pot method. The remaining difficulty—namely, the scaling of the pots—can be overcome by using special nickel steels that would not be greatly affected.



*View of the experimental furnace used*

nitrate for the world's needs is seemingly in no danger of being dissolved and carried away by the elements.

The igneous genesis is not unreasonable. It checks with other facts of the geology of the country and accounts for the originally tremendous volume, as well as the present large volume, and the wide variations in location at which concentrations are found. None of the theories previously advanced is adequate to account for the volume, either past or present, nor for the locations at which concentration exists.

The theory of igneous origin is not of course absolutely proven, and must rest to a certain degree on inference, just as does the theory of the magmatic origin of other orebodies. Personally I have no difficulty in accepting both. Others may not be so liberal.

As outlined in the beginning of this article, many almost magical sources have been invoked to account for the existence as well as quantity of Chilean nitrate, but the present advocated volcanic origin was also recognized by J. E. Spurr in his "The Ore Magmas" (pp. 510-511) and editorially in the *Engineering and Mining Journal-Press* of Dec. 2, 1922. Lindgren favors it in his "Ore Deposits," as does Mr. Whitehead in an article published in *Economic Geology*.

## Anaconda Makes Large Additions to Great Falls Plant

IN JUNE, 1925, the Great Falls reduction department of the Anaconda Copper Mining Co. started work on the most extensive addition to operating plants that the company has undertaken in Montana in several years, says *The Anode*, published by the safety department of that company. The work includes an extension to the zinc plant, an extension to the electrolytic copper refinery and to the furnace refinery, and an extension to the rod mill. The total cost for these extensions will amount to about $3,000,000.

Before the building of the zinc-plant extension, its capacity was 15,000,000 lb. of zinc cathodes per month and it was the largest electrolytic zinc plant in the world. The extension increases the capacity to 20,000,000 lb. of zinc cathodes per month for the enlarged plant. The extension in full operation requires 15,000 hp. of electrical energy, making a total requirement for the enlarged plant of about 60,000 hp.

The zinc-plant extension includes additions to the leaching division, the substation division and the electrolyzing division. The leaching division addition consists of a building 112 x 181 ft., 24 Pachuca tanks 10 ft. in diameter by 20 ft. deep, six Dorr tanks, 50 ft. in diameter, and various necessary items of equipment. The substation division has an addition to the original substation building 72 x 77 ft., three 5,800-kw. rotary converters which convert alternating current to direct current for use in the electrolyzing division, and other necessary electrical equipment. The electrolyzing division has a tank house extension 104 x 252 ft. Two hundred eighty-eight electrolytic tank cells have been added, together with some minor equipment. This addition makes a total of 1,164 electrolytic tank cells in the enlarged electrolyzing division. The buildings of the zinc plant extension are of brick, steel, concrete, and glass construction. Operation started in January, 1926.

In September, 1925, work was begun on an extension to the copper refineries. It is expected that this extension will be completed and be operating in May, 1926. The electrolytic copper refinery has a capacity of 17,500,000 lb. of copper cathodes per month as it is operated at present. The extension will increase this to a total capacity of 26,000,000 lb. of copper cathodes per month. The furnace refinery is being extended to have ample capacity to refine all of the cathodes produced by the electrolytic copper refinery and to re-treat such rod-mill scrap and other scrap as is delivered to it.

The copper plant extension includes an addition to the electric substation, an addition to the electrolytic refinery, small additions to the sulphate and silver slime plant and to the purification plant, a considerable addition to the furnace refinery, the building of an anode casting plant, and an extension of the refinery railroad yard with necessary additional railroad equipment.

The substation building is being lengthened to make room for two additional motor generator sets, making a total of seven motor generator sets in the station, which will furnish 10,500 hp. of direct current.

The electrolytic refinery tank room is being extended to the south by a building 152 x 252 ft., in which 480 refining tanks are being placed. This makes a total of 1,440 refining tanks for the enlarged plant, not including the starting sheet or stripper tanks. In the north end of the original refining tank room a section is added housing 30 stripper tanks for the production of starting sheets required by the increase in the number of refining tanks.

The building in which electrolytic slime is dried and sampled and in which bluestone is made has an addition of sufficient size to handle the increase in these branches which will result from the addition of refining tanks. Also, the plant for the purification of electrolyte is slightly enlarged.

The original furnace refinery building is being extended 153 ft. This extension will house a 500,000-lb. refining furnace of the same type as the two furnaces now in operation. With the new furnace there will be built a casting machine 40 ft. in diameter, and additional equipment will be required.

A new anode casting plant is being built, consisting of a brick building 130 x 100 ft., and a new casting furnace with necessary equipment for melting electrolytic anode scrap and for casting it into anodes to be returned to the electrolytic tanks.

Work on the extension to the rod mill began in October, 1925, and it is expected this mill will be completed and be in operation about July 1 of the present year. The rolling-mills department building is being extended eastward 150 ft. with the full width of the original building, 125 ft. The new equipment will include an oil-burning billet furnace similar to the furnace now in use, one double unit 18 x 64-in. roughing mill, which is a duplicate of the present No. 1 roughing mill, and an intermediate mill driven by an 800-hp. two-speed motor. At normal speed the intermediate mill will produce $\frac{3}{8}$ to $\frac{5}{8}$-in. wire-drawing rods, and at the lower speed it will produce larger round rods and flat rods. Also the extension will have two rod coilers and an unloading conveyor, pickling tubs, a roll lathe, and other necessary equipment. With the extension operating one shift per day, the capacity of the enlarged rod mill will be 15,000,000 lb. of rods per month.

The buildings of the extensions to the zinc plant, the copper plant, and the rod mill are designed and erected by company engineers.

perature of 900 deg. C. contains, however, only about two parts of carbon dioxide to 100 parts of carbon monoxide. This is principally because the carbon is very active at the latter temperature in reducing carbon dioxide to carbon monoxide. It is obvious, therefore, that in working at a temperature of 900 deg. C. no difficulty would be expected in regard to reversion of the sponge iron produced. On the other hand, no particular advantage would be derived from working at a higher temperature, because it would favor fusion and therefore result in insulating the interior portion of the ironstone from the action of reducing gases.

To test the conclusions arrived at, an experimental furnace was built. This furnace, which is illustrated on page 889, was rectangular in cross-section, being about 2 ft. wide, 4 ft. long and 9 ft. high. A number of air-admission ports or apertures were provided at varying heights on each side of the furnace. After blowing-in the furnace with fuel under conditions giving a satisfactory gas, it was periodically charged with equal parts of ironstone (56 per cent Fe) and charcoal. Both the ironstone and charcoal were of a size to pass through a 1½ in. diameter ring. Generally speaking, the result of working the furnace proved that the conclusions previously established were substantially correct. It was of course necessary to keep the grate free, so that the sponge iron formed would rapidly pass into the water seal. The product was crushed to —20 mesh and then passed over a Wilfley table, so as roughly to separate the sponge iron from ash and some of the gangue. After this operation the product had an average metallic iron content of 58 per cent. The furnace was simple to operate; in fact, under the conditions almost anyone could make sponge iron, because an excess of charcoal was deliberately added so as to avoid the possibility of reducing conditions. The furnace was worked until about forty tons of sponge iron had been made at the rate of from two to three tons per day.

It is obvious that magnetic separation could have been employed to obtain a higher grade of sponge iron, but as previously explained no particular advantage would have accrued therefrom, bearing in mind the purpose for which it was required.

Having definitely proved that sponge iron could be made, further work was stopped, as it was evident that with the experience obtained a furnace better suited for commercial operation could be designed.

The lessons learnt were:

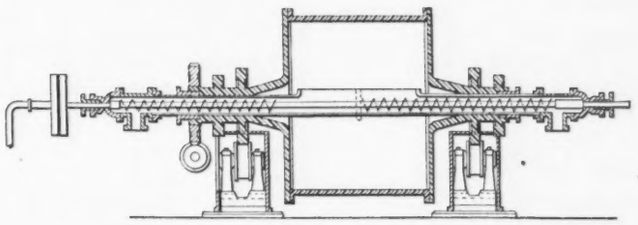
1. The necessity for a mechanically operated grate capable of being operated at a speed to discharge the sponge iron at a rate equal to its satisfactory reduction.

2. That the proper height of the furnace depends on the nature of the material to be used as fuel. The experimental furnace was used with charcoal, a comparatively expensive product. Coke was not available. By increasing the height of the furnace, wood fuel could be employed, in which case the upper part of the furnace would function to convert the wood into charcoal, which in the lower part of the furnace would reduce the ironstone.

3. The large amount of unconsumed charcoal found with the sponge iron indicated that an excess of the reducing agent had been added to the charge. Future work will of course be directed to reducing the quantity until the best proportion is found for the particular conditions.

4. The gas formed during the reduction is of course to be used for power or heating purposes. In this connection, the process can be compared with the conventional blast-furnace production of pig iron. The present process dispenses with flux, and therefore does not result in the production of a large quantity of slag carrying away a substantial quantity of heat, an advantage which is accentuated by the lower temperatures necessarily employed. In regard to the fuel required for the present process, it is a fair deduction that it will be less than the amount required in the blast-furnace production of pig iron.

An illustration of the new furnace is given on page 890, so that no detailed description need be given. It will be noticed that the reaction zone is spread to a comparatively large depth. The idea underlying the design is that a sufficient quantity of air is to be passed into the furnace from the first row of admission ducts above the grate, so that such air when it reaches the grate has been entirely converted to carbon monoxide. It is intended that a sufficient quantity of air be passed into No. 2 series of ducts so that the whole of such air will be converted to carbon monoxide by the time the downwardly passing gas reaches the level of No. 1 series of ducts, and so on. In practice it will be found that there will be some degree of overlapping.

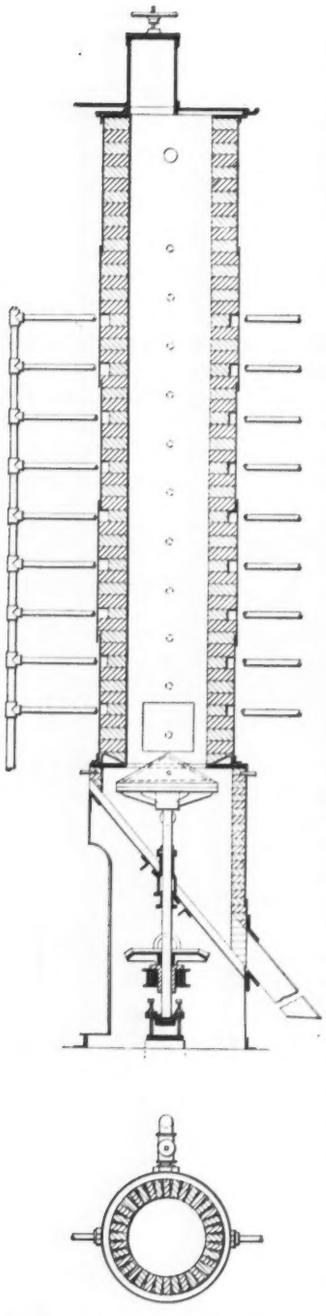


*Sectional elevation of externally heated rotating cylinder before being inclosed with brickwork*

It is thought that the producer or modified blast-furnace process above described is a satisfactory solution of the problem of making sponge iron, although doubtless many refinements will be worked out by operators in the field.

## Composition of Copper Mattes

Equilibrium conditions have been determined in the system Cu–S–Fe, in the liquid state, and at temperatures near the solidification point, according to an article by B. Bogitch abstracted in *British Chemical Abstracts (Compt. Rend.*, 182, 468). Ferrous sulphide and iron are miscible in all proportions in the liquid state, but addition of copper in amounts more than 3 per cent causes a separation into two layers, the upper high in sulphur content, the lower very low in sulphur content. As the amount of copper is increased, most of the metal passes into the upper layer, until its copper content reaches about 50 per cent. Copper added above this amount tends to collect in the lower layer, until this contains 94 to 95 per cent copper. Beyond this point, additional copper tends to collect in the upper layer. The limiting system $Cu_2S$–Cu, free from iron, consists, in the liquid state, of two conjugate solutions. The bearing of the phase diagram for the above system on the metallurgy of copper is discussed in the original article.



*Sectional elevation of sponge-iron furnace with air intakes at varying heights; of a similar design to a down-draft gas producer. The plan is a section at an air admission zone*

The basis of this work was the external heating of a rotating cylinder containing a mixture of ironstone and reducing agent. The first work done was on a very small scale, being carried out in a wrought-iron cylinder 12 in. in diameter and 15 in. long, flanged and provided with a cover at each end, to which suitable spindles were attached. A mixture of ironstone (56 per cent Fe) ground to —30 mesh and 30 per cent of carbon of the same fineness was heated for two hours in the furnace. On cooling, it was found that the product contained 40 per cent of metallic iron. It was then decided to build a larger furnace. This furnace was made of low-carbon cast steel 6 ft. in diameter and 4½ ft. long. An ingenious worm feed and discharge was arranged so that after discharging the product under non-oxidizing conditions by turning an internal launder 180 deg., the furnace could be recharged with fresh material. The construction will be apparent from the diagrammatic illustration on page 891. It was realized that scaling of the furnace was likely to be a serious factor at the temperature which it would be necessary to employ. Unfortunately, it was not possible to obtain the special nickel steels which are known to be resistant to scaling even up to a temperature of 1,000 deg. C. The best available material was a low-carbon cast steel, which could not be expected to be particularly resistant. Efforts were made to calorize this cylinder, but either because of the difficulty of handling so large an object, or through the faulty technique employed, the result was not satisfactory.

In operation, the cylinder was charged with 100 parts of —30 mesh ironstone (56 per cent Fe) and 30 parts of charcoal of the same degree of fineness. The cylinder was rotated at 4 r.p.m. and heated for four hours at a temperature of from 900 to 1,000 deg. C. Many tests were made, but it was not possible to obtain a product in which the contents exceeded 30 per cent metallic iron. The principal difficulties met with were the comparatively rapid scaling and the difficulty of maintaining the temperature to the required extent when using wood fuel. The work done suggested, however, that by using a cylinder of a smaller diameter and made of one of the known scale-resistant steels, sponge iron can probably be made at a satisfactory cost when suitable fuel is available. Work in regard to the indicated improvements was entirely suspended for the reason that a much better method had been developed.

### Producer Method or Modified Blast-Furnace Process

It occurred to the company's manager, P. W. Nevill, that if a proportion of ironstone was mixed with fuel and charged into a down-draft gas producer of the type common in Australia, then in passing through the furnace such ironstone would possibly become reduced to the metallic condition. Assuming such to be the case, it was evident that the resultant sponge iron would pass through the grate and drop into the water seal together with the ash. Assuming that the reduction actually took place, it was obvious that the method of discharging satisfied the known requirements in regard to cooling sponge iron. Attention was immediately directed to testing out the foregoing views, and for this purpose a proportion of ironstone was charged in at the top of a producer furnace together with charcoal. After a sufficient length of time had elapsed for the material to pass through the furnace, it was collected, with the result that the view expressed was found correct, in that a product was obtained which, after rough separation from the ash, contained 30 per cent of metallic iron. In passing through the producer, the material had decrepitated into smaller sizes. Many tests were made with varying degrees of success. Frequently the proper conditions were temporarily lost, with the result that the product obtained was entirely free from metallic iron. From the work done, the following deductions were made:

1. That it would be necessary to have a sufficient depth of reducing zone in which the required conditions would obtain, with the further provision that an excessive temperature at any particular point should be avoided.

2. That the gas producer conditions must be maintained so as to keep the carbon dioxide content of the gas sufficiently low.

Regarding the foregoing considerations, it was felt that the necessary conditions for a sufficiently spread reducing zone could be attained by having a comparatively large number of air-admission ducts at varying heights in the producer or furnace, and that the danger of fusion could be overcome by correct control of air admission. As regards the necessity for maintaining the gas sufficiently low in carbon dioxide, use was made of certain well-recognized facts. A gas containing more than about one part of carbon dioxide to ten parts of carbon monoxide will function as an oxidizing agent—or, in other words, if a gas containing such proportion or more of carbon dioxide be used, the reduction will be reversed and the iron re-oxidized. Furthermore, it is well known that in a gas producer, presuming a sufficiency of reducing agent, a gas produced at about 800 deg. C. contains about one part of carbon dioxide to ten parts of carbon monoxide. The gas produced at a tem-

# Discussion

*"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief. Letters will not be printed unless the author's name and address are known to the editor.*

## High Capitalization of Copper Companies Cuts Down Earnings per Share

THE EDITOR:

Sir—The question has been asked, "How is it that most of the copper companies are making little if any profit return on their capital?" and therein contained is a suggestion of the answer—"their capital." Almost all of the producing companies are old companies, that have been in the business for years, that have over-capitalized their original assets, as represented by actual cash investment for plant and mine; or the first plants have been superseded by later designs that are more efficient, thus adding to capital; or by devious other ways, until an estimate of copper in the ground owned by them, or of the copper produced per annum, in ratio to the par value of their shares, is very low—too low; so that when these companies have a very fair actual operating profit, by the time depletion, depreciation, current taxes and interest, and in some cases amortization charges are taken care of there is but a meager 2 or 3c. per pound of copper left for profit, for dividends on stock, and the return per share is low. Not the fault of copper, this, nor in fact with the present price of copper, but, in a large measure, the result of organization methods, or high finance, or whatever one prefers to call it.

Take as an elementary example a mine that has been partly developed to show 3,000,000 tons of ore that will assay 1.5 per cent copper and 0.10 oz. gold per ton, where mining and climatic conditions are normal. With present-day methods this ore can be treated, say, at the rate of 600 to 1,000 tons per day, with copper selling at 14c. per pound and gold at $20 per ounce, and where hydro-electric power can be made available at 0.3 to 0.5c. per kw.-hr., to show a profit of about $2 per ton of ore treated.

The mine and plant for such an operation, including hydro-electric power, will cost from $1,000,000 to $1,500,000. With a company organized with shares to the number of 25,000, on a basis of 1,000 tons per day the plant will produce per annum 9,500,000 lb. of copper. That is, at a rate of 380 lb. per share per annum. The profit will be about $750,000, or at a rate of $30 per share. In the 3,000,000 tons there is recoverable copper to the amount of 78,000,000 lb. That means for each share of stock 3,120 lb. of copper. The total profit to the operation, in 3,000,000 tons, will be about $6,000,000.

That is, if no more ore is found in subsequent development (and from experience with such mines it is quite probable more ore will be found), this plant will have run eight years, during which time, by the operation of a sinking fund, supported by an amortization rate included in the above estimated cost in lieu of depletion, depreciation, and other charges, there will have been created a cash surplus of $1,219,000 plus an earned profit of $6,000,000—on an investment of $1,500,000 in a modest copper mine, properly operated, with copper selling at 14c. per pound. This compares favorably with any ordinary industrial business. It must be remembered that thirty-four companies that are operating at present in the United States have paid out, according to published records, nearly $1,500,000,000 in dividends during their existence, and also that the demand for copper today is greater than it ever has been before in the world's history.

Vancouver, B. C. F. M. SYLVESTER.

## Why He Discontinued

THE EDITOR:

Sir—It is with keen regret that I am going to discontinue your esteemed *Engineering and Mining Journal-Press*, but, like the old prospector, "Holy cats! I'm done with minin'." It seems that this prospector of the old, hard-rock school surprised his many friends by leaving the hills and accepting a position as dishwasher in a small-town café. He gave his reasons as follows: When he first hit the hills a rattlesnake bit him, laying him up for a month; then his burro slipped on the trail and the ravens and magpies finished the job. He hit a missed hole, and for six months was in darkness until he could at least see—with one eye. A slab came down and put a kink in his back that knocked him out for a year. Thawing out frozen powder cost him three fingers and all his hair. A bad can of corn knocked him out for several weeks with a bad stomach; too much baking-powder biscuits just about finished the job, so that he lived on crackers and milk for many weary months. Then, when he hit a 4-ft. streak of pay dirt and was getting ready for a 2,000-point shipper, a determined claim jumper with a loaded "45" convinced him, by clipping off an ear and biting a chunk out of his right arm, that he was wrong and that he, the claim jumper, was right. Then he left the country, only to get caught in a snow-slide which took his cabin and himself for a wild ride down the mountain, where the cabin was ruined and he was picked up, more or less damaged, taking six months to repair the damage in the local hospital. By this time the old prospector was convinced that mining was out of his line.

So it is with me—after trying the game for some four years and losing my money and my reputation, and with the fitting climax of working for a mining company that hit a major fault and left the boys waiting for several months' pay, I have decided that mining is out of my line. Hence I will have no further use for my favorite magazine, the *E. & M. J.-P.* Besides, the five plunks at the present time is a good-sized grubstake for me. Should I ever come back and take to "mining" again, I

will surely subscribe for this publication, as necessary in mining as timber.

In conclusion, I will mention that I have spent many hours of pleasure and profit in the three years that I have been a subscriber of the *Engineering and Mining Journal-Press.* A PROSPECTOR.

## Ore Deposition in the Tri-State District

THE EDITOR:

Sir—An article by E. E. Ellis appeared in the Jan. 30, 1926, issue of *Engineering and Mining Journal-Press* under the heading "Occurrence of Commercial Zinc and Lead Orebodies in the Tri-State District," followed by comments of William F. Netzeband on the article in the April 17 issue.

During the last seventy-five years, outstanding geologists of the time have studied the ore deposits of the Mississippi Valley, and at least three divergent hypotheses have been advanced to explain the origin of these deposits. In recent years the "cold-water theory" exponents have had the prestige of the federal and state geological surveys behind it. Locally, these theories of ore deposition appear to be considered as having a purely academic appeal, and little credence is placed in them as guides to ore finding. The Tri-State district miner is prone to think of the ore horizon in the dimensions of a plane surface—so far have the "cold-water geologists" sold their wares. The possibility of finding lead and zinc minerals in commercial quantities in a lower horizon is not seriously considered, though deeper churn-drilling of tracts reported to have been "cut out" has repeatedly developed deeper orebodies. One is reminded of the producing history of the "blanket veins" of the Santa Eulalia (Chihuahua) district in Mexico. These mines have been "cut out" and abandoned several times in the last 200 years, only to be reopened as the result of deeper prospecting.

Many estimates have been made to show the probable life of the Tri-State mining district. These estimates have invariably been based upon the productivity of developed units which are applied to the weighted whole of the known mineralized area. Beyond this the engineer cannot of course go, but the estimated life of the district will be prolonged greatly if orebodies are found to exist below the present narrow limit of churn-drill prospecting. When the possibilities of a theory of ore deposition which encourages the conception of other and possibly far deeper ore horizons become known to the mining public, the school of magmatists will enroll a larger following.

Studies of the ore deposits of the West and of Mexico, and more particularly with reference to the occurrence of lead and zinc ores in the limestones of the states of Sonora, San Luis Potosi, Coahuila, and Chihuahua, early convinced me that certain of the hypotheses advanced by the Mississippi Valley geologists were not in accord with the genesis of the ores as determined by observations in areas where all the facts are available. The genetic relation of the fracture system to an igneous intrusive and of the ore deposits to the fractures is now generally accepted in most of the mining districts of the world.

Thirty-three years ago W. P. Jenney said: "The only theory which, in all observed instances, will account for the occurrence of deposits of lead and zinc ores and the associated minerals in the Upper and Lower Mississippi region is that of ascension, the source of the metals existing deep in the primitive rocks." J. E. Spurr concludes in the Feb. 16, 1924, issue of *Engineering and Mining Journal-Press,* in an article on the "Upper Mississippi Lead and Zinc Ores," that the solutions were hot solutions, and accordingly were ascending, and develops the hypothesis that the "ore runs" in this district overlie upward intrusions of igneous rock and that the fissures developed by the subsidence of these intrusives became channels for the magmatic solutions which deposited the ores.

The sequence of geological events recording the history of these great zinc and lead-mining districts may have been somewhat as follows:

Intrusion, in the Post-Cretaceous era, of intermediate-siliceous igneous magma from a southwesterly direction into the Pre-Cambrian formations.

Doming and fracturing of the Paleozoic sediments.

Silicification of the fractured zones by introduction of silica-bearing solutions condensed from magmatic emanations.

Deposition of blende, jasperoid, galena, calcite, and iron sulphides near the fractures and crevices in strata favorable to precipitation by reason of structural features and chemical composition.

Post-mineral faulting due to subsidence of the sedimentaries as the batholith cooled and contracted.

Erosion of about 5,000 ft. of sediments over a period of fifty or sixty million years, and, latterly, concurrent secondary concentration of the ores by descending oxidizing waters.

The erosional revolution which has been planing down the Mississippi province since the close of the Post-Cretaceous ore-deposition era may have some genetic relation to the lower-grade Aurora deposits. The increasing richness of the orebodies in the Tri-State district, progressing westward, as shown by the percentage recoveries cited by Ellis, is possibly due to erosional factors. The Aurora deposits are undoubtedly the roots of erosional remnants of narrow steeply pitching orebodies now removed. While these deposits are somewhat lower stratigraphically than the Oklahoma-Kansas producing horizon, the elevation above sea level is greater, and because they are located relatively higher up on the dome, they were subjected to more active erosional forces. The fact that secondary ore was mined from the "grass roots" would indicate that here erosion caught up with the secondary enrichment zone and planed off much of the high-grade ore, which has been saved to the miner further west by less active erosion and the presence of the cap of Cherokee shale.

The arguments favoring the deposition of the orebodies by descending waters advanced by Buckley and Buehler, and the idea of primary concentration of the ores by ascending waters proposed by Van Hise and Bain, together with the artesian-circulation theory put forward by Siebenthal—all these have had some important part to play in the long history of these deposits. However, until it is determined to the satisfaction of the drill prospector just where this ore came from originally—whether it came up, went down, or slipped in from the side somewhere—prospecting will continue to be done with the cart before the horse and the horse blind part of the time. CHARLES F. WILLIAMS.

Miami, Oklahoma.

# Consultation

## Two Inquiries on Nickel

"Kindly let me know who are the important buyers of nickel ore on the east coast of the United States, and also those on the west coast. Any information as to prices per ton delivered will be greatly appreciated."

There is practically no market for nickel ore in North America. The two principal smelters are the Mond Nickel Co., Coniston, Ont., Canada, and the International Nickel Co., Copper Cliff, Ont., but both of these companies smelt their own ores and buy little or no custom ore.

Some years ago the following concerns notified us of their willingness to buy nickel ore, and it may be that they are still in the market for small quantities:

O. C. Martin, 106 Stanmore Place, Westfield, N. J.

Winter, Wolff & Co., Inc., 42 Broadway, New York City.

Deloro Smelting & Refining Co., Deloro, Ont., Canada.

Siegfried Pels, 26-28 Neuerwall, Hamburg, Germany.

Louis Benzian, Hohe Bleichen, 35, Hamburg, Germany.

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"I should like some information regarding the production of nickel. Where in this country is it mined and treated? What is the annual consumption and the average price per pound? Are there any textbooks on the subject?"

No nickel ore is mined in the United States, though there are some small deposits. They cannot be mined as efficiently nor smelted as economically as the large deposits in the Sudbury district of Ontario, which supply most of the world's requirements. A small amount of nickel ore is also smelted in New Caledonia.

The two producing companies in the Sudbury district are the International Nickel Co. and the Mond Nickel Co. The former company has a refinery at Port Colborne, Ont., and maintains its principal selling office in New York City. The Mond Nickel Co. refines in Wales, and its principal outlet is the European market.

Most of the nickel sold is on long-term contracts, covering a year or more, usually at somewhat more favorable prices, for the consumer, than the metal is obtainable at in the spot market. The production and sale of the metal are closely regulated, presumably to secure the maximum profit to the producers over a long period of time, and quotations rarely change. The current price is 35c. per pound in the form of ingots. There is no daily market quotation as there is for copper or lead. Rather is the situation the same as that which obtains for aluminum. Demand is now somewhat better than before the war, owing to the diligence of the producers in developing new markets. Formerly, a large portion of the production was used for munitions, including armor plate for warships. The world's consumption in 1923 was 34,000 tons, in 1924 about 38,500, and in 1925 about 40,000 tons.

The only complete book on the subject of nickel that might be of interest to you is the Report of the Royal Ontario Nickel Commission, published a few years ago, and possibly still obtainable through the Ontario Department of Mines, Toronto.

## Market for Bismuth

"I should be much obliged if you could furnish me with the names of any purchasers in the United States of bismuth ores and concentrates or the metal. The ore is in the form of bismuth sulphide and bismuth carbonate."

Bismuth produced in the United States is a byproduct of lead ore smelted by the large domestic smelting and refining companies. The production is sufficient to supply the domestic market at the prevailing quotations, and it is doubtful if there is any market for raw material at the present time.

The correspondent probably is aware that the price of bismuth metal is in a sense artificially controlled. Messrs. Johnson, Matthey & Co., of London, determine a price for Great Britain, and the American producers translate that price into dollars and cents, making an allowance for foreign exchange, the cost of importation, and the duty. The reason for this is obvious. The British firm is willing and able to supply the requirements of the trade at its official price, and as supply and demand in the United States are practically balanced, it is impossible to get more than the London price, and manifestly it would be poor business to sell for less.

## Spodumene and Lithia

"I have what appears to be an unusual deposit of spodumene. The deposit is fairly accessible to power and could probably be refined or partly refined before shipment. Can you tell me something of the market possibilities?"

Spodumene is a lithium aluminum silicate carrying from 4 to 8 per cent lithium oxide. Large deposits are found in the Black Hills region in South Dakota, as well as in the New England States, in Sweden, and in Brazil. The price ranges from $20 to $40 per ton, depending on the percentage of lithium oxide contained in the ore. No important commercial uses of the metal itself are known. The most important compounds are lithium carbonate and lithium hydrate. The carbonate is used in the preparation of artificial mineral water and for certain medicines. It is worth about $1.50 per pound. The hydrate is used in the manufacture of certain types of storage batteries. For some reason not definitely understood, it greatly prolongs the life of the battery.

## Mineral Specimens

"Would you please inform me where I might be able to buy a small mineral collection?"

"The following firms or organizations have mineral collections for sale: Foote Mineral Co., 107 N. 19th St., Philadelphia, Pa.; Canadian Department of Mines, Ottawa, Canada.

# News of the Week

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## Summary

*HEARING before Tariff Commission June 21 to consider increased duty on magnesite—Bureau of Mines mineral exhibit at Philadelphia—Potash bill to come to vote soon.*

*Sampling plant at Kingman, Ariz., great help to small producers—Chloride mill nears completion — Tonopah-Belmont active in Arizona—Tom Reed milling 120 tons daily—Wenden Copper (Arizona) opens orebody on 650 level.*

*Bunker Hill opens high-grade lead-zinc ore in Ontario —Stemwinder begins shipment—Canadian Asbestos reports increased production in 1925.*

*Allouez conglomerates disappointing.*

*Mexico increases duty on machinery — German aluminum business lags—International Nickel enlarges refinery—Honduras adopts gold standard.*

*Katanga plans extensive development program—Jackhammer drills reduce mining cost on Witwatersrand.*

*Water transportation to Red Lake now available—Airplane service to Rouyn—Kirkland Lake drifts into good ore on 2,100 level.*

*Amalgamated Zinc (De Bavay's), Australia, reduces capital—Much interest shown in Tasmanian Tin.*

*Golden Center Mines, Inc., secures control of Candle Creek, Alaska, placers.*

*Boundary district, B. C., has two new silver veins.*

## U. S. Steel Corporation Has Spent $158,000,000 on Safety and Welfare Work

THE 1926 report of the U. S. Steel Corporation's Bureau of Safety, Sanitation, and Welfare shows that the Corporation has spent $158,000,000 for safety, sanitation, and welfare in the last fourteen years, the largest item being $45,000,000 for the relief of injured employees and of the families of employees killed. From 1912 to 1926 the Corporation spent $31,700,000 for sanitation, $28,000,000 for playgrounds, schools, clubs, gardens, visiting nurses, and similar activities, $15,700,000 for accident prevention, $13,000,000 in pensions, and $22,000,000 for the employees' stock-subscription plan. Twenty years of organized accident prevention has saved 46,000 men from death or serious injury, has averted accidents which would have disabled 322,000 other workmen, and has resulted in a very large saving of money to the company, and happier days for the employees.

Arthur Williams, president of the American Museum of Safety, says: "This is the most astounding record of accomplishment in accident prevention and health promotion that I have seen in the fifteen years of my association with the safety movement. The report is remarkable not only because of the magnitude of the expenditures shown, but because of its striking evidence of the extent to which industrial accidents may be prevented. When such industries as are represented by the plants of the United States Steel Corporation can show a reduction of more than 60 per cent in fatal and other serious accidents and a reduction of more than 80 per cent in the less serious but disabling accidents, there is no longer excuse for the failure of any industry to give the utmost attention to organized accident prevention."

The report indicates that it is now a common occurrence for large steel plants to operate for months without a single disabling injury to a workman. It is shown, for instance, that the Joliet works of the Illinois Steel Co., with an average employment of 3,200 men, went 116 consecutive days without a single disabling accident. The Universal Portland Cement Co., with an average of 3,600 men, operated two months without a disabling accident. The Edgar Thompson works of the Carnegie Steel Co., averaging 5,400 men, operated for 67 consecutive days without accident. The Duluth plant of the Steel Corporation, employing 500 men, came through the entire year without a single injury to a workman sufficient to cause the loss of a day's time.

For the comfort of employees 66 restaurants are maintained in the Corporation's plants, where food may be obtained at cost, 39 clubhouses for the use of employees and their families, and 169 fully equipped playgrounds for their children, as well as an extensive visiting nurse service, practical housekeeping centers, and good-fellowship clubs. The latter, managed entirely by employees, render assistance in case of illness or financial distress and serve as social centers.

On January 1, 1926, according to the report, 47,647 employees were registered stockholders in the Corporation, holding an aggregate of 163,802 shares of preferred and 501,999 shares of common stock. There were also 6,327 additional employees paying for stock on a partial payment plan.

### Do Fire Drills Pay?

That training for mine safety pays was fully demonstrated by the Pickands Mather Co. when the Utica mine, three miles west of Hibbing, Minn., was discovered afire May 2 threatening to throw 150 miners out of work. Within an hour after the alarm came in, mine safety crews were mobilized from as far as Gilbert on the east and Kewatin on the west end of the Mesabi range and thirty men were fighting the fire. The blaze was put out and operations were resumed on May 3.

### Low Accident Fatality Rates in Missouri Mines

APPROXIMATELY 10,000 miners are employed in Missouri, 6,000 being in the zinc and lead mines and 4,000 in the coal mines. Only six men engaged in metal mining in the state lost their lives in 1925, and eleven engaged in coal mining, according to Frank Fenix, of Joplin, chief mine inspector.

As there were a total of thirty-eight fatalities in the Joplin-Miami field in 1925, with about 9,000 men employed, it would appear that the showing for Missouri is much better than for the Joplin-Miami district, where there were four and two-ninths fatal accidents for every 1,000 men employed.

## Wenden Copper Encounters Ore at 650 Level

Considerable interest is centered on the recent developments of the Wenden Copper Mining Co., Wenden, Ariz., which has been sinking a double-compartment shaft on its property in the Cunningham Pass area, 11 miles from Wenden. The Wenden shaft is over 100 ft. from the dike, and the immediate ground on the surface gives no indication of ore. At a depth of 650 ft. 30 ft. of ore assaying 4 per cent copper and some gold has been encountered.

This district has been noted for its surface ores, considerable high-grade ore having been shipped. As no deep work had been done, there has always been a doubt as to whether the ore continued at depth. The striking of ore in the Wenden shaft indicates that there are large deposits of ore at depth.

## Sampling Plant at Kingman Doing Good Business

The town of Kingman, Ariz., is becoming quite active, as it is the distributing point for the mining industry of the district. Every day new machinery, drill steel, and other mining supplies can be seen on the railroad platform awaiting shipment by truck to some outlying property. Trucks laden with simple or complex ores can be seen discharging their loads at the sampling plant. F. W. Manson, owner of the plant, states that since the sampler was opened in 1925 the number of shippers of ore at Kingman has increased from less than half a dozen to 125. About 100 cars of ore, mostly zinc, are being shipped from the sampler to custom smelters each month. Shippers of small lots are given the benefit of the carload freight rates, and no sampling charge is made unless the ore is high grade. The sampling plant at Kingman has been of great assistance to the small producers of the district. Mr. Manson is also operating the Hillside mine, 32 miles northeast of Kingman, which is producing 50 tons of 50 per cent zinc ore per day.

## Golconda Plans New Mill

At the property of Golconda Mines Consolidated, Inc., in Hinsdale County, Colo., about three miles from Animas Forks, development under David Fleming justifies the erection of a mill. The company intends having extensive tests made to determine final design. Construction is expected to start this summer.

## Tonopah Belmont Opens Mine in Arizona

The Tonopah Belmont company is making extensive arrangements to start mining on a large scale at Camp Belmont, 28 miles southwest of Wickenburg, Ariz. The company has already spent $200,000 and has appropriated $300,000 more to open the property.

Ore was discovered early in 1925 by Charles Barnes, who had a lease and bond on the property. He opened up a sufficient high-grade lead ore, while sinking a winze, to enlist the aid of the Tonopah Belmont company. In addition to carrying on development work the company has drilled a 500-ft. well for water, and is constructing mine buildings and installing machinery. A telephone line is being built from Camp Belmont to Wickenburg. About 75 men are employed.

*Part of construction force employed on Inspiration leaching plant*

## Chloride Mill Nears Completion

It is expected that the mill of the Chloride Mining Co., Chloride, Ariz., which has been under construction for some time, will be in operation by Aug. 12. The plant is a 300-ton selective-flotation mill and will start operations with the treatment of 150 tons daily. Complex ores, which have hitherto been a problem, will be handled in the new mill at a good profit. Lead and zinc are the principal ores produced in the Chloride properties. W. B. Twitchell, of Phoenix, Ariz., is president of the company.

## Tom Reed Mill Handling 120 Tons of Ore Daily

More than 120 tons of ore is being handled by the Tom Reed mill, at Oatman, Ariz., daily, and this tonnage is assured for some time to come, according to officers of the mill. The Schmidt-Shank-Aztec lease, the McCullough-Penny lease, the Siders-Adams lease, and the Mexican lease, near the east end of the Ben Harrison mine, are supplying the mill.

## Prehistoric Remains Found Embedded in Salt Cake Deposit

The skeleton of a prehistoric man was recently unearthed in the sodium deposit at Camp Verde, near Jerome, Ariz. It was badly broken up by the steam-shovel operations, the head being completely lost. The skeleton appeared to be that of a man over five feet and six inches in height, and was found 80 or 90 ft. below the surface.

## Quicksilver Property Plans Extensive Development

The Arizona Cinnabar Quicksilver Mining Co., Globe, Ariz., with claims representing 380 acres, 70 miles north of Globe, on the Roosevelt Dam-Payson highway, will immediately make a contract for three development tunnels. L. E. Foster, of Silver City, N. M., is in charge of operations.

### Two New Silver Veins in Boundary District

Two important new strikes have been made in the Boundary district of British Columbia. Duncan McIntosh and Harry Lee have struck what is believed to be the downward extension of the Tennis Court shoot in their Bell mine, near Beaverdell. This shoot was first opened underground, and then the upward extension was found accidentally in grading for a tennis court. This portion of the shoot has yielded approximately $80,000 in silver and lead. The new vein is about 5 ft. wide.

An 8-ft. lode, showing wire and ruby silver freely, has been opened by a tunnel on the Imperial group, at Rock. The ore is high-grade silver. The property has been bonded by J. W. Clarke and associates, of Spokane, for $75,000. Mr. Clarke and his associates are interested in several mines in the district, and they hold a lease on the waste dump at the Providence mine, at Greenwood, from which they have been shipping picked material, assaying around 30 oz. of silver per ton.

The Federal Mining & Smelting Co. is closing down work on the Bounty claim, near Beaverdell, and withdrawing from the district.

### Burma Corporation Produces 439,337 Oz. Silver in April

During April of this year, 30,477 tons of ore was mined, including 3,984 tons of high-grade ore, by the Burma Corporation, Ltd., A total of 23,300 tons of ore was milled, producing 7,156 tons of lead concentrates. Refinery products were 4,400 tons of refined lead and 439,337 oz. of refined silver. The experimental zinc plant produced 4,150 tons of zinc concentrates, assaying 12.9 oz. silver, 7 per cent lead, and 45.4 per cent zinc. In addition to the above, 850 tons of copper matte was produced from the treatment of accumulated smelter byproducts, and 3,263 tons of copper ore.

### Mexico Increases Duty on Machinery

The Mexican import duties on parts of mineral grinding machines have been changed, with certain items formerly free now made dutiable, effective June 18, according to a cable dispatch received in the U. S. Department of Commerce from Commercial Attaché Alexander V. Dye, Mexico City.

### Mutual Gold Opening Old Colorado Mines

At the close of last year, the American Nettie, Jonathan, and Pony Express mines, in the Uncompahgre district of Ouray County, Colo., were consolidated as the Mutual Gold Mines, Inc., the acquisition of the Wanakah group, with tramway, mill and smelter forming also part of the program of manager P. F. Welch and his Denver backers. The upper and lower tunnels of the Pony Express are now served with air from the Syracuse tunnel compressor of the Bachelor Consolidated company.

# News From Washington

By PAUL WOOTON
Special Correspondent

## Hearing on Application for Increased Duty on Magnesite June 21

QUESTIONS involved in the proposed increase in the rates of duties on crude magnesite and caustic calcined magnesite will be considered at a public hearing before the U. S. Tariff Commission June 21. The application for the increase in duty comes from the Sierra Magnesite Co., of Chicago, and from C. S. Maltby, of San Francisco.

At present magnesite which has not been purified is dutiable at the rate of $\frac{5}{16}$ of 1c. per pound. Caustic calcined magnesite is dutiable at $\frac{5}{8}$ of 1c. per pound. These rates are equivalent to $6.25 per short ton on crude magnesite, or $12.50 per short ton on caustic calcined magnesite. The specific rate is equivalent to an ad valorem rate of 69 per cent of the declared value in 1925 of lump caustic magnesite from India, and 39 per cent of the declared value in 1925 of ground caustic magnesite from the Netherlands, where Grecian lump caustic is ground.

In 1923, 73.6 per cent of the caustic magnesite consumed in this country was used in stucco; 12.8 per cent in flooring; 6.9 per cent in chemicals; 1.5 per cent in insulation; 1.2 per cent in rubber manufacture, and 4 per cent for miscellaneous purposes.

In view of the very strenuous objections which have been raised in connection with the ruling on flue dust, arrangements have been made to conduct a hearing at which all concerned may present their point of view. The date for the hearing has not been set.

In defending its position in requiring the payment of duty on flue dust at the rate of 2½c.—the same as metallic lead—the Customs Division of the Treasury Department declares that there is no way to classify this material other than as a manufacture of lead under the basket clause of the act. Flue dust is not the specific thing known as matte, nor is it ore, it is declared. Therefore, it is argued that it has been advanced beyond the state of ore which would make it a manufactured product.

#### Countervailing Duty on Iron and Steel Protested by Importers

An agreement between the Raw Steel Syndicate, of Duesseldorf, and the Association of Iron Consuming Industries, of Germany, has been interpreted by the Customs Division of the Treasury Department as an export bounty on German pig-iron and rolling-mill products. As a result, collectors of customs have been ordered to suspend the liquidation of entries until the amount of the countervailing duty can be determined. This is another step in the vigorous campaign of the customs authorities to add to the duty bonuses or bounties which are enjoyed by foreign producers.

Producers of pig iron in British India are understood to be preparing to contest legally the recent action of the Treasury Department in ordering a countervailing duty assessed against pig-iron imports from that country, which are the indirect beneficiaries of a bounty paid on finished products. It is contended by the customs authorities that the bounty stimulates pig-iron production and that a portion of the 12 rupee bounty should be assessed against that commodity. This is the first time a countervailing duty has been prescribed under such conditions. The importers contend that the effect of the order is to levy an embargo against the particular pig iron affected.

#### Bureau of Mines Prepares Mineral Exhibit

The U. S. Bureau of Mines is preparing a mineral exhibit for the Sesquicentennial Exposition at Philadelphia. One of the features will be the presentation of samples of metals which the public rarely sees. Glass tubes will be coated inside with such metals as rubidium, caesium, didymium, lanthanium, gallium, germanium, and thallium. Samples of the major metals will be shown in the form of six-inch balls. These balls will be attached to a standard by a chain. In this way visitors can handle them and compare their weights.

A new policy is to be observed by the Bureau of Mines in connection with the issuance of mineral resources chapters. These chapters in the future will include a survey of the world situation in the particular mineral being treated. Chapters including this feature recently have been completed on tin, quicksilver, manganese, and chrome. Some weeks will elapse before printed copies are available, owing to the congestion in the Government Printing Office.

Development of heat-resisting glass is resulting in considerable substitution of that material for mica, it is reported to the Bureau of Mines. This glass now is being used successfully, it is stated, in blast furnaces, in the windows at the tuyères, and in other furnaces and stoves where transparency and resistance to great heat are required. Glass manufacturers also report that they are electro-plating the inside of glass-pressing molds with chromium, and as a result are being able to get as many as 21,000 good impressions from a single mold.

#### Potash Bill to Come to Vote Soon

An effort is to be made to secure the approval of the potash bill by unanimous consent. So far as is known at this writing there is no opposition to the measure as reported out by the Committee on Mines and Mining. In case objection is made to the bill when it comes up on the unanimous consent calendar, assurances have been given that a special rule will be forthcoming which will permit of a vote on the measure at this session of Congress.

## Trio Mines Increases Power Plant and Development Continues

Trio Mines Co., of Delaware, controlling a property at Mogollon, N. M., has recently added to its power plant more than 300 hp. of Diesel equipment as prime mover, and will electrify the mine and mill. With increased capacity and changes in mine methods, and automatic handling of rock in mine and mill, it is confidently expected that operating costs can be materially reduced below any previous costs in the camp. The Mogollon camp contains a large tonnage of ore that its distance from railroad, high transportation, and cyanidation costs have left untouched. The recent completion of a good road from Silver City to Glenwood has already reduced freight costs from $1.25 to 75c. per hundred.

The company owns the Deadwood mine, which is the south extension of the old Last Chance mine, and a 50-ton stamp mill and cyanide plant. The mine is developed to the 500 level, with 1,800 ft. of drifting on the vein. The vein is 10 to 30 ft. wide, assaying about $10 per ton in gold and silver. The company also owns the Gold Dust and Iron Bar groups, with excellent indications for developing a large tonnage of milling ore.

*Deadwood mill, Trio Mines Company, Mogollon, N. M.*

## Water Transportation to Red Lake Now Available

The rush to the Red Lake gold area in the Patricia district of Ontario, which was halted for some time by the breaking up of the winter roads, has set in in greater volume than ever with the opening of navigation. The Sioux Lookout Transportation Association has placed eleven boats on the route. Rates have been fixed at $12 to Pine Ridge and $20 to Red Lake. There is a daily service, the trip from Hudson to Red Lake occupying three days. Much attention is being directed to the Woman Lake section, where about six hundred claims have been staked.

A bill introduced in the Canadian Parliament for the construction of a railroad from the Canadian National Railway to Red Lake by a private corporation has been disapproved by the Railway Committee.

## Bingo Mine to Erect Small Mill

The Bingo Mine, Herb Lake district, Manitoba, will proceed with the erection of a ten-ton ball mill, which has been ordered by Joseph Myers, managing director, and a thorough test of the possibilities of the property is to be made.

## Zinc-Lead Deposits to Be Developed on Calumet Island

Much interest is marking the activity of the syndicates interested in the zinc and lead deposits on Calumet Island, about 40 miles northwest of the city of Ottawa, Canada. American and Canadian interests have pursued a quiet but extensive campaign of staking during the winter months, and one of the largest English mining corporations has, through its Canadian subsidiary, British Metals Corporation (Canada), Ltd., now definitely entered the field.

The ores on Calumet Island are rich in zinc and lead, and on some of the properties at the lower end of the island there are substantial values in silver. One of the largest bodies of sulphide ore on Calumet Island has an exposed width of over 500 ft., and is regarded as being one of the most interesting prospects of its kind in Canada. Other properties are held by the Calumet Lead & Zinc Syndicate.

## Allouez Conglomerates Disappointing

Although a crosscut is being driven southeast in La Salle lands by Calumet & Hecla Consolidated, the failure to uncover values in the long crosscut northwest to the Allouez conglomerate is considered disappointing. In the 2,400 ft. traversed by the crosscut a score or more of veins, including three conglomerates, have been opened, but none contained copper in sufficient quantity to warrant extensive drifting. It was regarded generally as a promising stretch, and the outcome naturally is a matter of regret. The fact has been quite definitely established by numerous exploratory projects that the famous Calumet conglomerate vein is not mineralized except within the confines of Calumet & Hecla proper.

## Kirkland Lake Drifting Into Good Ore

Drifting operations at the Kirkland Lake Mine, Kirkland Lake, Ontario, on the 2,100 and 2,225 levels, show increasing gold content. The last section of the vein drifted on the 2,100 level is stated to show ore averaging $40 per ton. On the lower level the drifting is in about 120 ft. compared with 130 ft. on the 2,100 level, and the drift is just striking the richer ore. Drifting is in an easterly direction toward the Teck-Hughes property. It is understood that there is enough ore on hand to warrant beginning milling, which is expected to be started within the next two months.

## Madonna Mine Leased

Stanley Walker and associates, of Denver, Colo., have leased the Madonna mine, in the Monarch district, Chaffee County. In company with Fritz Eilers, son of Karl Eilers, the principal owner, and Landon F. Strobel, Mr. Walker recently inspected the property, which consists of twelve patented claims and shows an orebody with gold, silver, lead, and zinc.

## Micky Breen Mine to Reopen

A Denver company, headed by George W. Weldon, is planning to reopen the Micky (Michael) Breen mine, in the Uncompahgre district, Ouray County, Colo., near the mouth of Poughkeepsie Gulch. Old stopes are credited with 300,000 tons of broken low-grade, lead-zinc-silver ore, that can be treated at a profit by selective flotation. There is an old mill that can be remodeled.

## U. S. Production of Crude Platinum 343 Oz. in 1925

Total production of crude platinum in the United States in 1925 was 343 oz., according to reports from mine operators compiled by the U. S. Bureau of Mines. This output is more by 92 oz. than the purchases reported by refiners.

Mine operators in California in 1925 produced 312 oz. of crude platinum, which was sold for $36,000, or $115 an ounce, and 19 oz. of crude platinum was produced in Oregon and sold for $2,100, or $111 an ounce. Alaska produced 12 oz. of crude platinum in 1925.

## Castle-Trethewey Developing Large Ore Reserves

The Castle-Trethewey mine, Gowganda, Ontario, has now been developed to a stage where it has the largest ore reserves of any silver mine in northern Ontario. Work at the present point of operation is extensive, but large sections of the property are still undeveloped. On one of these sections a new shaft is to be put down.

## What Is Milled Ore

The decision of Judge R. R. Ryan of the Sixth Judicial District of the State of New Mexico in the case of R. H. West, plaintiff, vs. S. S. Warren and J. L. Hougland, defendents, is of interest in its bearing on what constitutes "milled ore."

The question to be decided was, "Is

the process of treatment to which the manganese ore is subjected at the mine, 'milling,' so that the ore so treated is 'milled ore' within the meaning of the contract upon which a royalty of 5 per cent is paid?" In this case, the ore was screened, sized, and jigged at the mine. The defendents contended that the ore was not milled and that the term "milled ore" applied only to ore that was either crushed or ground or both, and that the product in question was not a milled product.

The court held that the terms "milling" and "milled ore" are in common usage among mining men and the mining profession and that all the testimony in this case is to the effect that the process of treatment to which the manganese ore was subjected at the mines was "milling" and the ore so treated is "milled ore."

## A.S.&R. Dock at Baltimore Destroyed by Fire

The wharf belonging to the Baltimore plant of the American Smelting & Refining Co. was badly damaged on May 20 by fire which is believed to have had its origin in the fertilizing plant that adjourns the dock. Damage is estimated at about $300,000. The copper plant itself was not touched by the fire.

## Stemwinder Mine Begins Shipment

Porcupine Goldfields Development & Finance Co. has begun to ship ore from the Stemwinder mine, adjoining the Sullivan mine, at Kimberley, B. C., to the concentrator at Trail. The first two consignments totaled 654 tons, which is expected to yield 20 per cent zinc, 8 per cent lead, and 4 oz. of silver per ton. More than 100,000 tons of this grade of ore has been developed above the 125-ft. level.

## Canadian Asbestos Production Surpasses Previous Years

During 1925 sales of asbestos in Canada, which supplies more than 80 per cent of the world's production of that commodity, surpassed those of all previous years, coming to 259,037 long tons, valued (at mill) at $8,995,854, according to the U. S. Department of Commerce. These figures include all sales of the industry, with fillers, floats and other short fibers, sand, gravel, and crushed rock, in addition to the crude. Sales of crudes alone amounted to 149,959 tons in 1925.

## Mexican Metal Production Shows Large Increase in Zinc

The Bureau of Mines of the Mexican Government has just issued a statement showing the metal production of this country for the year 1925, as compared with 1924, as follows:

**Metal Production of Mexico, in 1924 and 1925 (Kilos)**

| | 1924 | 1925 |
|---|---|---|
| Gold | 23,647 | 24,478 |
| Silver | 2,844,104 | 2,821,058 |
| Lead | 164,140,130 | 164,288,016 |
| Copper | 49,113,194 | 49,533,644 |
| Zinc | 18,936,336 | 45,743,143 |
| Mercury | 36,665 | 38,721 |
| Antimony | 774,567 | 1,276,084 |
| Arsenic | 1,293,436 | 3,948,564 |
| Graphite | 8,023,417 | 3,839,228 |

# Toronto Letter

*By Our Special Correspondent for Northern Ontario*

## Northern Ontario Produces $2,787,711 Gold in April—More Copper Ore Near Rouyn

The gold production for northern Ontario mines for the month of April amounted to $2,787,711 from 301,361 tons of ore treated. In Porcupine 260,064 tons were treated, the recovery being $2,169,921, an average of $8.35 per ton. The McIntyre appears to have replaced the Dome as the second largest producer. In the Kirkland Camp 41,197 tons were milled, the recovery being $617,184, an average of $15 per ton.

The Judicial Committee of the Privy Council has dismissed, with costs, the appeal of the Attorney General of Quebec against the Nipissing Central Railway. This appeal involved the right of the Dominion Government to grant to the Nipissing Central—an Ontario government-owned railway—the right-of-way across crown lands in the Province of Quebec. The Quebec Government has consistently opposed the extending of the Kirkland Lake branch of the Nipissing Central into the Quebec fields, in order, it is believed, to preserve as far as possible the business arising out of the mining district, for the benefit of business firms in Quebec. The Province of Ontario is now free to apply to the Dominion Government for an Order-in-Council defining the route for the proposed extension into Rouyn.

### More Copper Ore in Western Quebec

There is a great deal of activity in Boischatel and Montbray townships, which lie between Rouyn and the Ontario boundary. On the Alderson-McKay property diamond drills have cut 21 ft. of massive copper ore carrying zinc and galena. This appears to be the extension of an orebody indicated by the magneto-metric survey, which has proved very successful in that section. This property is under option to Noah Timmins, president of the Hollinger, and indications point to its rivaling in importance the Waite-Montgomery, also under option to Mr. Timmins. On the Halliwell group, also under option to the same interests, surface work has indicated promising copper showings. The Noranda has a substantial acreage in this district, and the Pioneer company, organized by Huronian Belt interests, has undertaken to spend $8,000 a month on the East Arnfield group. The West Arnfield group is under option to the Porcupine Goldfields Development & Finance Co. The Consolidated Mining & Smelting Co. has the ground east of the Alderson-McKay and is preparing for an active summer. Coniagas has ground in the same district, as well as the Nipissing, which now has diamond drills at work.

Diamond drills working on the Amulet have recently cut new ore in three holes; assays are not yet available, but the ore is believed to be important. This company is planning to start construction of a concentrating mill as soon as the railway from O'Brien is completed. The mill will have a capacity of 100 tons a day, and the concentrates will eventually be treated at the Horne smelter.

### Airplane Service to Red Lake and Rouyn

Air service to the Red Lake field has now started from Hudson. Most of the flying, however, will be done between Pine Ridge and Red Lake, as fast boat service is available from Hudson to Pine Ridge, so that the complete trip into the district can easily be made in one day. No news is yet available from the district, as there has been no mail out since the break-up.

It is announced that the Elliott-Fairchild Transport, Ltd., will run a plane service between Haileybury and Rouyn, starting about the end of May. In the meantime water transport to the district is somewhat impeded on account of the number of logs in the rivers.

## Bunker Hill Development Reveals High-Grade Lead-Zinc Ore

As a result of the operations carried on by the Bunker Hill & Sullivan interests at Chelmsford, in the Sudbury district, Ontario, lead-zinc deposits have been indicated which would appear to warrant development on an extensive scale. Great importance attaches to this occurrence, as with the exception of the Sullivan mine, in British Columbia, this is considered the most extensive recent lead discovery. Approximately $250,000 has been spent in diamond drilling and other work within the last ten months, and fully 50,000 ft. of diamond drilling has been done. It is understood that details in connection with metallurgical practice have been decided upon.

## Additional Machinery Sent to Barren Lands

The *Edmonton Journal* reports that W. A. Dunne, who located a block of high-grade silver-lead claims, on the Barren Lands, to the east of Fort Smith, Northwest Territory, has shipped another 100 tons of machinery, including a diamond-drilling outfit, to the claims and has ordered two eight-ton Fokker bombing airplanes, which are on their way to Edmonton, and are expected within a few days. The planes will be used to maintain supplies at the claims. The trip by air will take only a few hours, whereas the journey by canoe and its concomitant portages takes five weeks.

## Magnetometer Findings Proven by Diamond Drill

The Don Rouyn, operating in Rouyn Township near Noranda, Quebec, has obtained important results in diamond drilling by the use of the magnetometer. In the mineralized zone a little north of the center of the group of claims a diamond drill encountered commercial ore at a depth of 150 ft. On another mineralized zone, located near the southern boundary of the block, diamond drilling encountered 40 ft. of very good ore. The indications of the magnetometer proved to be accurate in each instance.

## Golden Center Mines, Inc., Acquires Candle Creek Placers

On April 27 negotiations were concluded with Joseph Pheby, one of the owners of the Candle Creek Placer Gold Mines, for the transfer of its holdings to the Golden Center Mines, Inc. The properties extend 5½ miles along Candle Creek, 200 miles northeast of Nome, Alaska, with additional ground optioned. The gold-bearing gravel bed is said to be 12 ft. thick and several hundred feet wide, containing approximately 24,700,000 cu.yd. of gravel. About $800,000 has been spent in equipping the properties' two dredges, thirty-seven miles of ditches and pipe lines for hydraulic mining, necessary buildings, and supplies. A test run of 259,289 yd. of gravel by dredging and hydraulic mining is reported to have returned $1.30 a yard. The capacity of present equipment is 500,000 cu.yd. annually. Plans are under way increasing the capacity of the dredges. C. L. Hersham, mining engineer, has been enaged to manage the properties and has left for Alaska to begin immediate operations.

## Delamar Mine Under Lease and Bond

Development work at the old Delamar mine, Delamar, Lincoln County, Nev., has recently disclosed $12 gold ore in the west drift. The work is being done by Ellis and Horn, local mining men, who have the property under lease and $60,000 bond from the Delamar Exploration Co., owners. The Delamar mine was formerly a substantial producer of gold.

Shipments from the Prince and Virginia Louise mines, Pioche, Nev., are going forward at the rate of 50 tons daily. The ore is mixed at the ratio of two cars from the mine and one car from the former second-class ore dump, as a great demand now exists for fluxing ore at the United States Smelting Co.'s plant. Both the Bristol Silver mines and the Black Metals property are shipping, the total production approximating 500 tons weekly.

George Z. and Lyman Smith are leasing on the Bristol Silver mines and are now engaged in driving a development tunnel toward the May Day workings.

## Flowery Mines Mills 165 Tons Per Day

It is reported that the Flowery Mines Co., operating a gold property in Six Mile Canyon, a few miles from Virginia City, Nev., is milling 165 tons of ore per day. Construction indebtedness will be cleaned up within the next few months, and substantial profits are practically assured for stockholders, as it is estimated there is at least two years' ore reserve in sight. Costs are low, due to the character and size of the orebody, which is mined by shrinkage and glory-hole methods, and to the simple metallurgy required.

The Flowery property was opened by the United Comstock Mines Co. several years ago, and after this company relinquished its working option the present holders secured the property and constructed the mill.

# Melbourne Letter

**By Peter G. Tait**

*Special Correspondent*

## Co-operative Company Proposed for Osmiridium Mines

**Melbourne, April 20**—The Tasmanian Government has evolved a plan to help the osmiridium miners on the Adams River field. It is proposed to form a co-operative company, in which all the miners would be shareholders. The Commonwealth Bank is prepared to advance 60 per cent of the current London price, and the metal will be shipped to London through a well-known firm of buyers, who will act as the bank's agents. If the present buyers' licenses are cancelled and all the metal is marketed through the one channel the co-operative company will certainly be able to control the market, but whether the miners will get better prices depends on the demand.

### Amalgamated Zinc to Reduce Capital

Amalgamated Zinc (De Bavay's) has applied to the court for permission to return £300,000 of capital to its shareholders. The petition filed by the company stated that the company was incorporated in 1909 to acquire, treat, and prepare for market ores, tailings, and concentrates. The capital was £500,000, divided into 500,000 shares of £1 each. All the share capital had been issued, and £1 a share paid up. By a special resolution passed this year the company resolved that the capital be reduced from £500,000 to £200,000, divided into 500,000 shares of 8s. each, and that such reduction be effected by returning to shareholders 12s. per share. It was proposed that this return of capital be made by distributing among the shareholders 300,000 ordinary shares of £1 each now held by the company in the Electrolytic Zinc Co. of Australasia, Ltd. The company has £300,000 of capital in excess of its wants. Montague Cohen, solicitor, a director of the company, stated in an affidavit that the company has paid more than £1,175,000 in dividends. At the date of its last balance sheet, Dec. 31, 1925, the company's assets amounted to £687,899. Owing to exhaustion of available raw material, the company has, during the last two years, greatly restricted the scope of its operations, with the result that the capital was now in excess of requirements. It will be remembered that last year the company proposed to embark on a new enterprise, the manufacture of paper from wood pulp in Tasmania, but this was dropped, as the Commonwealth Government did not agree to the company's proposal in regard to a bonus on production.

### Interest Shown in Tasmanian Tin

The high price of tin ruling recently has led to renewed activities on the part of a number of smaller Tasmanian tin mines, and several new companies have been floated. One of these, the Aberfoyle Tin Mining Option Co., is developing a property about 2½ miles from Storey Creek Tin Mines, which has produced £177,000 worth of tin and wolfram. The last-mentioned mine has been working for eleven years and is down only 160 ft. The ore contains 24.18 lb. tin oxide, and 31.18 lb. wolframite per ton. Mining costs are £1 5s. 7d. and treatment, including separation, 8s. 10d. per ton mined. The owners of this property are considering increasing the output.

### Australian Institute Holds Meeting in June

The Australian Institute of Mining and Metallurgy is holding its annual meeting at Newcastle at the beginning of June. Newcastle is not only the center of the coal-mining industry: it has grown to a great manufacturing district. Among the works to be visited by the Institute are the Broken Hill Proprietary Iron and Steel Works, the Australian Wire Rope Co.'s works, Rylands wire, and Lysaght's galvanized iron works and the Commonwealth Steel Products.

## Coeur d'Alene Shows Increased Profits

THIRTEEN mining operations in the Coeur d'Alene region yielded a net profit of $8,791,761 in 1925, according to reports filed with the county assessor of Shoshone County recently. This is an increase of $2,345,000 over the record of the last previous year. The gross value of the ore produced in 1925 was $24,233,250, an increase of nearly $2,000,000 over the production for 1924.

## Chalk Mountain Continues Development

The Chalk Mountain silver-lead district, in Churchill County, Nev., has been quiescent for some time, for the reason, principally, that more attention is being given to development than to production. The Chalk Mountain Silver-Lead Co., the principal shipper of the district, has recently concentrated development operations on a winze from the 210 level, and on lateral work from the 335 level. Car No. 45 is ready to ship. Other properties are working, but no important developments have been reported.

## Simon Silver-Lead Elects Officers

The annual stockholders' meeting of the Simon Silver-Lead Mines, Inc., operating at Simon, Nev., was held in Mina on May 3. Directors and officers elected for the ensuing year were as follows: Jasper T. Robinson, president and general manager; Walter S. Tyler, vice-president; George C. Whitney, secretary-treasurer; Walter Luther Dodge and George A. Legg, additional directors. J. Lee Bennet was reappointed general superintendent.

Development work is being carried on in the mine on various levels, but the 250-ton flotation concentration plant will not be placed in operation for several months at least. An assessment of 3c. per share, delinquent June 7, was levied to take care of current development expense.

# Johannesburg Letter

By John Watson
*Special Correspondent*

## Large Development Program Planned for Katanga—Interest in Platinum Strong

**Johannesburg, April 20.**—Describing a motor trip along Africa's great watershed, from Katanga to the Lobito line rail head, a special correspondent to *The Star* recently said that the road to Tshilongo goes via Panda, where the Union Minière has copper-leaching and copper-smelting works, and where phenomenally high-grade ore is being mined from the side of a hill. It is said that £7,000,000 will be spent in this area, during the next three years, on further development, by which time the Katanga should outstrip Chile as one of the world's biggest copper producers. The railway from Lobito Bay is being built by Robert Williams & Co., with British capital, to link up with the Cape to Congo line, near Elisabethville.

Early in April a special correspondent, describing Potgietersrust and the district of which it is the center, referred to the important factor of the mining industry in the development of this town. The tin mines of that district have provided employment and added to the trade of Potgietersrust for many years. Now, the discovery of platinum has given a great stimulus to enterprise generally. Potgietersrust Platinums, Ltd., is opening up its mines, 14 miles to the northwest of Potgietersrust. On April 1, fifty-two white men and more than a thousand natives were employed by that company.

The Financial and Mining Supplement of *The Star*, of Johannesburg, issued on March 16, contained a special article on "Platinum: Its Statistical Position," by D. C. Greig, of Johannesburg. *The Financial Times*, of London, issued the following day, associates itself with Mr. Greig's cautious attitude, saying he has emphasized afresh, and with the corroboration of Sir Richard Redmayne, views which have been held, all through, in London. *The Financial Times* urged, months ago, that the richest properties — Onverwacht and Transvaal Platinum—though comparatively small, should produce as much as possible, as quickly as they could, before the possible eventual large supplies from the extensive low-grade deposits should come on the market.

On April 14, the T. C. L. issued the following report: Onverwacht reduction plant milled 856 tons during March, yielding 252 oz. of platinum and allied metals. The decrease in yield was due to the bulk of ore milled being taken from a marginal zone, which is of lower grade than the central portion. During February, 654 tons of ore yielded 424 oz. of platinoids.

The profit of the Anglo-American Corporation of South Africa for last year amounted to £672,653, an increase of £122,050 over that for 1924. In addition to gold, the corporation has extensive interests in copper, platinum, and diamonds in south and southwest Africa, in Rhodesia, and on the Congo border.

On the Johannesburg Stock Exchange during the past week T. C. Land shares were heavily dealt in. There was considerable fluctuation, daily, in this stock, which has declined during the week from 53s. 6d. to 45s. 3d. Business in gold shares was only moderate. Potgietersrust Platinums were dealt in largely throughout the week, and their price has receded from 7s. 9d. to 6s. 10½d. per 5s. share.

## German Aluminum Business Below Expectations in 1925

German domestic and foreign business in aluminum products is said not to have met the expectations of German producers in 1925, although an increase was noted in the consumption of raw aluminum for the production of light metal alloys, according to a report to the U. S. Department of Commerce. On the other hand, domestic consumption of aluminum for other uses was not up to standard.

On Oct. 1, 1925, import prohibitions formerly in effect against raw aluminum, subject to permit, were removed. Unexpectedly, raw aluminum was freed from duty under the current preliminary tariff now in effect, in replacement of the former system of import-export control. German bauxite imports increased from 118,434 tons in 1924 to 282,158 in 1925. In spite of the falling off of imports of Istrian bauxite later in the year, Italy was the chief source of supply, furnishing 141,162 tons, or 50 per cent of the total. France supplied 133,544 tons and Denmark 3,000. Exports were trifling—about 476 tons. Germany imported 10,719 tons of raw aluminum in 1925, compared with 5,471 in 1924.

## Sumitomo Produces 2,802,149 Lb. Copper in February

During February of this year the Sumitomo Goshi Kaisha, of Osaka, Japan, produced 2,873,285 lb. of crude copper, from which it obtained 2,802,-149 lb. of refined metal, or at the rate of nearly 17,000 short tons per year. This is a private concern owning the Besshi copper mine, 34,000 acres of timber land, a number of coal mines, and a copper smelter 20 miles from the mine.

## International Nickel Enlarges Colborne Refinery

Construction has been started on the addition to the electric refining unit at the Port Colborne refinery. An entirely new plant is being constructed, which will be completed about October, and this will increase the output of electrolytic nickel to 1,000,000 lb. a month.

## Honduras Adopts Gold Standard

The Honduras Congress on May 27 adopted a law establishing the gold standard for that country's currency, which has been on a silver basis. The new currency unit will be called the "lempira" instead of peso. By the same law, the circulation of foreign silver currencies in the country is forbidden, the only legal tender being the currency of Honduras and the United States.

# London Letter

By W. A. Doman
*Special Correspondent*

## Central Mining & Investment Corporation Issues Annual Report Showing Increased Efficiency

**London, May 11**—The Central Mining & Investment Corporation, which had made arrangements for the printing of its annual report, has now issued that document. Taken as a whole it makes good reading and shows that the sphere of the corporation's activities has widened. It has interests now in Venezuela, Spain, Egypt, Brazil, and French Indo-China. As I mentioned on a former occasion, it is no longer associated with the Diamond Syndicate, and in consequence has largely disposed of its holdings in diamond-mining companies.

The review of conditions on the Witwatersrand is interesting, particularly in connection with the use of jackhammer drilling machines. On this subject the report states that the average monthly fathomage of rock broken in stopes at the mines of the group increased from 67,193 fathoms during the six months ended Dec. 31, 1924, to 68,386 fathoms during the corresponding period of 1925, but, despite this marked increase the number of natives engaged on this work was reduced from 6,543 to 5,046, the efficiency for the period having improved from 10.3 to 13.6 fathoms per "boy," or 32 per cent. The progressive reduction effected in the number of natives engaged in rock-breaking is of special importance in counterbalancing the unavoidable increase, as the mines get deeper, of the number of "boys" employed in connection with the support of underground workings and in mitigating the adverse effect of periodical shortages of native labor.

Further important economies have been effected in the use of explosives, the consumption of nitroglycerine for stoping purposes being reduced from 0.399 lb. per ton broken during the latter half of 1924 to 0.351 lb. during the corresponding period of 1925, an improvement of 12 per cent, while the average strength of the explosives used fell from 49.1 per cent to 45.1 per cent. The total consumption of nitroglycerine for stoping in 1925 was 9.7 per cent less than in the previous year, notwithstanding the increased fathomage broken.

The corporation is largely interested in platinum mining, and on the farm Onverwacht, in the Lydenburg district, it reports the existence of a payable deposit. The crude platinum is forwarded to London in regular consignments, and satisfactory arrangements have been made for its refining and marketing. The average cost of producing an ounce of gold in 1925 was 63s. 2d., against 62s. 11d. in 1924.

An important new copper discovery has been made in Northern Rhodesia between the Kafue and the Lungwe rivers about 100 miles south east of Kasemba Magistracy. The strike extends for over seven miles, and the outcrop is being actively prospected. Values are stated to be exceptional.

# Societies, Addresses, and Reports

## W. H. Morse Tells San Francisco Section About Norway's Mines

### Sundry Resolutions Adopted at Monthly Meeting of A.I.M.E.—Want Federal High-Grading Law

At the monthly meeting of the San Francisco Section of the A.I.M.E., H. W. Morse described his recent experiences in Norway, where he went to examine certain massive pyrite-pyrrhotite deposits in northern Norway, 100 or more miles beyond railroad transportation and in the Grong district. One such deposit is over 3,000 ft. wide where exposed, and by diamond drilling a maximum thickness of 200 ft. and an average thickness of about 75 ft. has been determined. The length is indefinite. Dr. Morse characterized the occurrence as a lathlike orebody intruded into schists, but stated that several divergent opinions relative to the genesis of the deposits are held. The ore from similar deposits in Norway was the source of considerable profit until the opening of the great sulphur mines of Louisiana and Texas. Calcines resulting from the burning of the ores are treated at central plants, of which there are a dozen or more in Europe. A chloridizing-leaching operation is used for the recovery of the accessory gold, silver, and copper.

Commenting upon the general situation, Dr. Morse stated that it rained every day in August when he was there and that everything was wet. Everyone who is anyone in Norway knows everyone else, as Norway is a small country with only two or three large centers. The people impressed him by the high average standard. The country is a hard country to live in and the man who works in Norway works hard. Many water-power projects are yet to be developed. Manufacturing based upon the utilization of water-power is not necessarily dependent upon the availability of raw materials in Norway, as water-borne freight can be brought to many points at low cost. Of the important questions confronting the Norwegians, the one that looms largest is what part shall be taken by foreign capital in developing water-power and other resources. The people are divided on this issue. Turning again to the subject of the great sulphide orebodies, Dr. Morse stated that the ores could be treated by flotation, but the Norwegian government did not want the iron and sulphur to be thrown away and was therefore actively working upon methods for the utilization of all possible products from the ore.

Dr. Morse next turned the attention of his fellow members to Santa Rosalia, Lower California, and briefly described the copper ore deposits of the Boleo copper company and its metallurgical operations. He stated that the deposits of copper ore are in the nature of beds dipping at an angle of 12 deg. or more to the southeast and underlying an area of about 40 square miles. The ore beds are of varying thicknesses, and are from 150 to 200 ft. apart, being separated by conglomerates and tuffs. Of the four beds, one has been worked upon the dip to a depth of 1,000 ft. The ores are sulphides in the lower zone and contain several rare copper minerals. No explosives are used, and the mining methods are similar to those used in coal mining. Reverberatory smelting has displaced blast-furnace smelting. The mines have been worked since 1885.

The Triumpho deposits south of La Paz were also visited by Dr. Morse. The mineral area is 16 to 18 miles long and 8 to 10 miles wide and is close to the south tip of Lower California. Numerous veins occur, and where these are cut by transverse dikes complex orebodies containing silver, lead, zinc, and antimony occur at the intersections.

#### Important Resolutions Adopted

J. M. Hill, of the U. S. Bureau of Mines, reported that the California "high grading" law was operating with a fair degree of success, but that the need for federal legislation was now apparent. He moved that the San Francisco section go on record as approving the efforts of California mining interests to secure a federal law which will make more difficult the disposal of stolen bullion through the government mints. The motion was passed. Mr. Hill then moved that the chairman appoint a committee to make a study of California mine taxation and to cooperate with the Commonwealth Club of San Francisco in an effort to secure a better mine-taxation law. The motion was passed. He next moved that a committee be appointed to study the Klamath River situation where a group of "sportsmen" were endeavoring to prevent placer mining in the region of the Klamath and Trinity Rivers and to close these watersheds to all placer mining work. The motion was passed. The section is thus definitely lined up to make some effort to solve three vexatious mining problems.

## Finance Blast-Furnace Slag Study

The American Institute of Mining and Metallurgical Engineers, after careful investigation, has recommended an appropriation by Engineering Foundation to aid Professor Richard S. McCaffery, head of the Department of Metallurgy of the University of Wisconsin, in continuing a study of blast-furnace slags. This investigation was undertaken to determine the quality of different iron blast-furnace slags as desulphurizing agents and the possibility of using in the blast furnace materials of higher sulphur content than is now usual. The solution of the problem would render feasible the use of higher-sulphur iron ores for pig iron, the use of coke containing more sulphur than is now practicable, and the economical manufacture of irons and steels of lower sulphur content. This research promises results of great importance not only to the iron and steel industries but to several others and to the users of their products. The board of Engineering Foundation has voted financial assistance.

## Fellowships at Wisconsin

A number of research fellowships in metallurgy are available at the University of Wisconsin at Madison. The fellows are to carry on metallurgical research in iron and steel and will be given an opportunity to work for a master's or a doctor's degree. A good reading knowledge of French and German is very desirable, and applicants should hold the bachelor's degree at least.

Application should always be accompanied by certified abstracts of the academic work done by the applicant, by a statement of practical experience, copies of letters of recommendation, and a small recent photograph. The stipends are $1,200 yearly, with a vacation period of one month. Fellows holding these fellowships will begin work in September, 1926. Further information may be obtained from E. R. Shorey, assistant professor of mining and metallurgy, University of Wisconsin, Madison, Wis.

## British Columbia Division C.I.M.M. Elects New Officers

The British Columbia division of the Canadian Institute of Mining and Metallurgy has elected the following officers for the ensuing year: Charles A. Banks, chairman; R. W. Brock and Graham Cruickshanks, vice-chairman; T. W. Greaves, D. McEvoy, G. F. Monk, S. J. Schofield, and N. Thompson, executive committee; R. W. Haggen, Vancouver; James Jemson, Lantzville; G. P. Jones, Hedley; A. J. Langley, Revelstoke; D. Lay, Hazelton; J. I. Moore, Britannia Beach; E. G. Montgomery, Kimberley; C. B. North, Premier; W. F. Robertson, Victoria; and W. R. Wilson, Fernie, divisional committee. H. Mortimer Lamb was elected secretary-treasurer. On May 1, the British Columbia division entertained A. Randolph Bruce, Lieutenant-Governor of British Columbia, at a dinner, to celebrate the appointment of one of the members of the institute to the highest position in the province.

The Chamber of Mines for Interior British Columbia will hold a convention at Nelson, B. C., on July 5 to 7, inclusive.

## E. D. Adams Gives $100,000 to Engineering Societies Library

A gift of $100,000 by Edward Dean Adams to Engineering Foundation and Engineering Societies Library was announced on May 19 by W. L. Saunders, president of United Engineering Society and chairman of its endowment committee. Mr. Adams, in appreciation of his service as vice-chairman of Engineering Foundation for ten years, was elected an honorary member for life. The only other honorary member of the Foundation is the founder, Ambrose Swasey. Mr. Adams was presented a beautifully bound and illuminated vellum book recording the testimonial and signed by all present and former members of Engineering Foundation Board. The announcement of his large gift came as a surprise to the profession.

# People You Should Know About

**W. H. Wiley** has been in Tonopah, Nev., on professional work for the West End Consolidated Mining Co.

**Bailey Willis,** professor emeritus of geology at Stanford University, is in Washington on a business visit.

**J. C. Beam,** of the Geologic Branch of the U. S. Geological Survey, will soon leave Hawaii to return to the United States permanently.

**T. A. Jaggar, Jr.,** of the Geologic Branch of the U. S. Geological Survey, sailed from Hawaii May 22 on the way to Washington.

**John A. Burgess,** mining engineer of San Francisco, has taken over the management of the Eureka-Holly Mining Co. at Eureka, Nev.

**Ira B. Joralemon,** mining engineer of San Francisco, has been in Tonopah, Nev., on professional work for the West End Consolidated Mining Co.

**Albert Silver,** consulting metallurgist of Tonopah, Nev., has returned to Tonopah from a professional trip to Mexico which lasted for several months.

**J. B. Reeside** and **E. T. McKnight,** of the Geologic Branch of the U. S. Geological Survey, have left Washington for work in the Green River district of Utah.

**Kenneth C. Browne,** until recently general manager of the Phosphate Mining Co., Nicholas, Fla., is temporarily living at 51 Lincoln Circle, Crestwood, N. Y.

**Dean Dexter S. Kimball** of Cornell University announces that a "safety and production study" has been started by the American Engineering Council, of which Dean Kimball is president.

**Otto Herres** has been elected chairman of the Utah section of the A.I.M.E.; **Ernest Gayford** is the new vice-chairman; and **C. T. Van Winkle** has been re-elected secretary-treasurer.

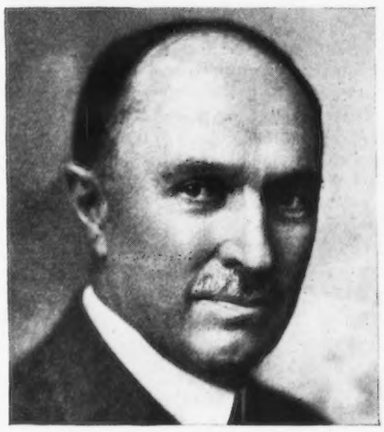
**E. J. Conway,** who has been chief field engineer for the Granby company for some time and has been with the company since 1912, has resigned to enter practise in Vancouver, B. C.

In an article on "Mining Bentonite in California," which appeared on page 841 of the May 22 issue of *Engineering and Mining Journal-Press*, the statement was made that C. S. Ross is connected with the Geophysical Laboratories. This is in error, as Mr. Ross is with the U. S. Geological Survey.

**E. P. Mathewson,** New York consulting geologist, recently addressed the regular monthly May meeting of the Utah section of the American Institute of Mining and Metallurgical Engineers, on "The Rio Tinto Mine," and also the Salt Lake Chamber of Commerce Mining Committee on "The Outlook for Mining."

**J. H. Crosby,** who was elected a vice-president of the Transvaal Chamber of Mines on March 29, succeeded **Professor Lawn** in December, 1923, in Johannesburg, and is now general manager of the Johannesburg Consolidated Investment Co., Ltd. He is South African by birth and has been for many years associated with the Barnato group of mines.

**Lloyd Root,** State Mineralogist of California, is in Washington, D. C. It is his intention while there to consult with Secretary Hoover, R. J. Grant, Director of the Mint, and Chief Moran, of the Secret Service Department, in an effort to work out some plan to safeguard gold mining and reduce the losses due to "high-grading" in gold mines, particularly in the State of California. It is estimated that the loss from this cause amounts to an aggregate of $500,000 per annum out of a total state production of $13,000,000.



*Colonel Seeley W. Mudd*

**King Alfonso of Spain** on May 24 officially opened the International Geological Congress being held in Madrid. The attendance was large, about thirteen hundred geologists and engineers having come from every important country. The delegates will be received at the royal palace at the conclusion of the meeting, on May 31. *Engineering and Mining Journal-Press* was represented at the congress by **T. A. Rickard.**

**Philip N. Moore,** mining engineer of St. Louis, Mo., presided and acted as toastmaster on the occasion of a complimentary dinner given at the Coronado Hotel, in St. Louis, on May 17, to Edward E. Wall, C. E., on his retirement after thirty-four years of continuous service to the City of St. Louis. Mr. Wall had long been a Director of Public Utilities of the city. The testimonial was a tribute from the Associated Engineering Societies of St. Louis and the Engineers' Club of St. Louis. Nearly three hundred men were present. An appropriately engraved testimonial was presented to Mr. Wall.

## Obituary

**Colonel Seeley Wintersmith Mudd** died at St. Luke's hospital, St. Louis, Mo., on May 24, after having undergone a major abdominal operation on the train while he was being taken from Los Angeles to New York. He had been suffering from a malignant tumor.

Colonel Mudd was born in Kirkwood, Mo., in 1861, the son of Henry Thomas and Sarah Elizabeth (Hodgen) Mudd. He was graduated from the Washington University, at St. Louis, with the degree of Engineer of Mines. His first position was as assayer, later as superintendent, in the copper department of the St. Louis Smelting & Refining Co., where he was employed from 1883 to 1885. From there he went to Leadville, Colo., where from 1887 to 1912 he served as manager of the Small Hopes Consolidated and Boreel mining companies. From 1899 to 1902 he was also manager of the Ibex Mining Co., which operated the Little Johnny mine, near Leadville. For the next two years he acted as consulting engineer in the West for the New Jersey Zinc Co. Consideration of the health of one of his children caused him to move to Los Angeles in 1903. In the two years following he was consulting engineer on the coast for the Guggenheim Exploration Co. and the American Smelting & Refining Co. It was at this time that he brought to the attention of the Guggenheims the Dairy Farm property, in California, and the Utah Copper deposit in Bingham Canyon. He resigned in 1905 and in 1907 became actively associated in developing the Ray Consolidated as a large producer of low-grade ore. From then on he was engaged in general examination and consulting work and spent much time in seeking out for himself and associates desirable properties and improving them. He was president and manager of the Queen Esther Mining & Milling Co. from 1904 to 1909. One of his interesting experiences was in connection with the United Eastern Co. at Oatman, Ariz. Appearing to be no more than a promising wildcat at first, this property developed rich ore at depth and eventually yielded abundant return in profits. Colonel Mudd was mainly responsible for the acquisition of the famous sulphur deposits controlled by the Texas Gulf Sulphur Co. and was actively connected with their early development. He was a director of the company at the time of his death. He was also a limited partner in the firm of Foster, McConnell & Co., New York.

The World War took Colonel Mudd into a different line of work, that of Assistant Director, under D. C. Jackling, of the United States explosives plants. From this work he was discharged in 1919 with the rank of colonel, after which he resumed his consulting work in Los Angeles.

Colonel Mudd was president of the Cyprus Mines Corporation and of the Coeur d'Alene Syndicate Mining Co., as well as a director in the Ray Consolidated, United Eastern, and Alaska Juneau. He was a member of the A.I.M.E., the Mining and Metallurgical Society of America, of the Institution of Mining and Metallurgy in England, and of several clubs. He was a trustee of Pomona College Southwest Museum. In politics he was a Republican and in religion a Congregationalist. In 1887 he married Della Mulock, of New York, who survices him with his two sons, Harvey S. Mudd, of Los Angeles, also a mining engineer, and Dr. Seeley G. Mudd. An appreciation of Colonel Mudd's life and career will appear in an early issue.

# Recent Technical Publications

Reviews, Abstracts, and References

## Metallurgical Progress

**Metallurgy and Its Influence on Modern Progress.** By Sir Robert A. Hadfield. Published in London. American agents, D. Van Nostrand Co., New York. Price $7.50.

It is seldom that a treatise on metallurgy is considered interesting reading for the general public as well as for members of the metallurgical profession. In this work Sir Robert A. Hadfield presents the subject in such a fascinating manner that what he writes will be understood and appreciated by all. The many references he makes to practical results obtained, in discussing progress in the art of metallurgy, add in no small manner to the value of the work.

Part I is devoted to history, and in the chapters entitled "The Birth of Science," "The Rise of Steam," and "The Twentieth Century," the author gives a most interesting description of the work of others and the early history of metallurgical progress. He pays a marked tribute to the many eminent scientists and workers who have been responsible for this development and dwells on the influence early scientific research work has had on this progress. In the chapter entitled "The Twentieth Century," attention is called to the great achievements which have been and are being accomplished in many scientific and engineering branches. The author cites especially the enormous train loads which are being hauled, and gives as an example one train which was hauled by a single locomotive over the Virginian Railroad, this train being one and one-sixth miles long and carrying a gross load of 15,400 tons. As another example, he mentions the rapid advances that have been made in metallography, which, as the author states, owes its origin to the late Dr. H. C. Sorby. The progress which has taken place in this important branch of metallurgy is illustrated by a joint paper by the author and T. G. Elliot, on "Photomicrographs of Steel and Iron Sections." In this paper it is shown that it is now quite possible to prepare and examine metallurgical micro-sections of 8,000 magnification. To illustrate what this means, the polished section under micro-examination is about ¼ in. square; if the whole of this area were magnified 8,000 times it would yield a square occupying an area of approximately three-fourths of an acre.

Not only in the first part of the work does the author refer to and enlarge upon the contributions of others, and give them full credit, but he does this throughout the entire book. At the same time it was of course necessary for him to mention and describe his own work and the developments which have resulted therefrom, and these descriptions are naturally intensely interesting.

Part II is devoted to metallurgy; especially to the rise, importance, and influence of alloy steels, the subject to which the author has devoted much time and attention and upon which he very naturally enlarges. He expresses the idea that we are passing out of the age of simple steel and that we are advancing into an era which may be justly termed "an age of alloy steels," for without the use of such steels it is certain that modern civilization could not be carried on. The chapters on the properties and use of manganese and silicon steels, heat treatment, microstructure of steels, and the application of special steels, including non-rustable iron, give an excellent description of these products and the reason why they have influenced modern progress. The economical importance of these alloy steels is well known, but even many engineers will be amazed at the statement that on account of its durability in heavy service one ton of manganese steel will do the work of about ten tons of ordinary steel.

Part III deals with the use of fuel, in the consumption of which the metallurgical industries have made such striking advances from time to time, without, however, even now having reached anything like the desired goal. In this connection, steps which might have been taken to increase economies and to improve results are mentioned.

The value of and the part played by scientific societies is dwelt upon in Part IV. Especial attention is naturally paid to British institutions, some of which have been in existence for many years. At the same time, reference is made to the American engineering societies and to the part they have played and are playing in the world's progress.

The author devotes considerable space to a description of the numerous researches which have been conducted in different countries on the properties of carbon and alloy steels, as regards their manufacture and composition, heat treatment, and metallographic examination. He states that as the result of these researches, conducted by scientific workers, the art of metallurgy has been taken out of the dark paths of empiricism and metallurgy has now in fact become a part of science. The rise of education and research and their interdependence is discussed in Chapter XII, and in Chapter XIII the author makes some pertinent remarks on educational methods and facilities.

In concluding this work, Sir Robert speaks of the future of science and urges workers in science not to be discouraged, but to remember the old saying that "he who ceases to aim at better things will cease to do good things."

A. L. WALKER.

**Safety in Metal Mines**—E. A. Hodges, State Metal Mine Inspector for the Industrial Commission of Utah, Salt Lake City, has prepared a practical little booklet of safety rules for the protection of metal miners. It is clearly written in plain English with definite recommendations for the conduct of a man underground and is intended to be put in the hands of all employees. Copies may be obtained from the commission.

**Katanga Radium**—The "General Geology of the Katanga Radium Deposits" is the subject of a three-page article in *The Mining Magazine* for April (London; price, 1s.). The author, Henry W. Turner, says that 80 per cent of the radium now being produced comes from the deposits of uranium ores in the Belgian Congo. Practically all comes from the Chinkolobwe copper mine, and is shipped to the reduction works at Oelen, near Antwerp, Belgium. The principal minerals are pitchblende and gummite. No details are given as to the occurences.

**Canadian Mining**—Statistics of mineral production and the names of the principal producers are given in "Statistical Review of Ontario's Mineral Industry in 1923," by W. R. Rogers, issued as Part 1, Vol. 33, of the annual reports of the Ontario Department of Mines, pp. 63, obtainable on request from the Department at Toronto.

The economic minerals of Quebec are described in an illustrated bulletin of 40 pages recently issued by the Quebec Bureau of Mines, Quebec, Canada. A map on which all the principal mineral occurrences are noted is enclosed. Copies are obtainable on request.

Canadian Geological Survey Summary Report 1924, Part B, obtainable on request from the Geological Survey, Ottawa, contains the following papers: "Oil and Gas Prospects of the Wainwright-Vermillion Area, Alberta," by G. S. Hume, pp. 22; "Wapawekka and Deschambault Lakes Area, Saskatchewan," by J. S. DeLury, pp. 28; "Geology and Mineral Deposits of Oiseau River Map Area, Manitoba," by J. F. Wright, pp. 54; and "Deep Borings in the Prairie Provinces and North West Territories," by E. D. Ingall, pp. 12.

Memoir 143, published by the Canadian Geological Survey at 30c., is by W. H. Collins and discusses the general character, stratigraphy, structural geology, correlation, and economic geology of the area along the north shore of Lake Huron. Several maps are included, including one each of the Bruce mines, Blind River district, and Lake Panache.

The annual report of the Canadian Department of Mines for the fiscal year ending March 31, 1925, is now available for 15c. from the Department at Ottawa. It is a bulletin of 75 pages, briefly outlining the various activities of the organization, with quite a bit of statistical matter.

Part 4, vol. 34, 1925, of the report of the Ontario Department of Mines, Toronto, Ont. (pp. 56; free), contains chapters on the "Mississagi Reserve and Goulais River Iron Ranges, District of Algoma," by E. S. Moore, and "The Whiskey Lake Area," by G. Vibert Douglas. There is also brief reference to "La Cloche Area (District of Sudbury)," also by Mr. Douglas. Several colored geological maps are inclosed.

Bulletin No. 56 of the Ontario Department of Mines, Toronto, obtainable on request, gives up-to-date information on the Red Lake and adjacent areas for prospectors and others planning to visit the district. A colored geological map is included.

# New Machinery and Inventions

## One-Piece Frame Used in New Diesel

### En Bloc Design Adopted by Manufacturer for Engines of More Than 100 Hp. Per Cylinder—Marks Advance in Development

While the en bloc design, wherein the cylinders are cast as a unit with the frame, is a feature of many automobile engines as well as other small powered units, the adoption of this design by the Fulton Iron Works for Diesel engines of over 100 horsepower per cylinder marks a new advance in oil-engine development.

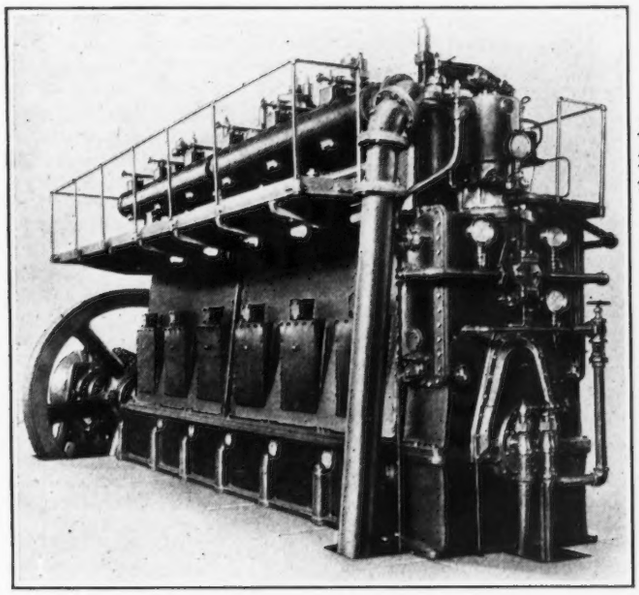


*Fig. 1 — Compressor end of new engine.*

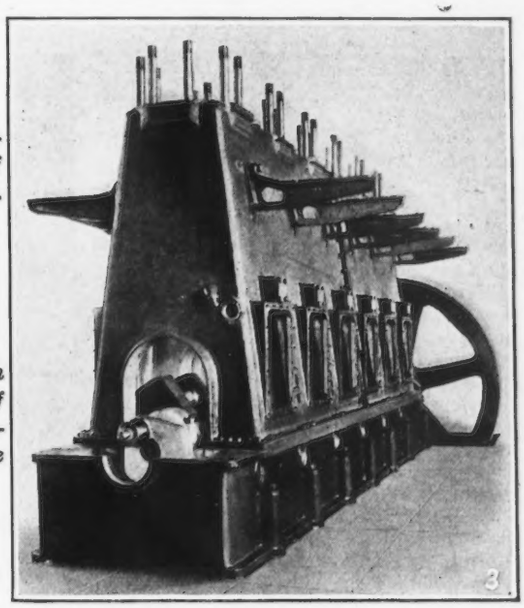


*Fig. 3 — En bloc frame of 6-cylinder engine of the type described.*

The bedplate, which serves as the bottom of the crankcase, carries the crankshaft bearings in double-webbed cross-members. The en bloc casting rests upon the bedplate and extends from this plate to the top of the cylinder liners. As a result all stresses are transmitted from the cylinder head to the bedplate through a solid casting.

In effect the frame assists the bedplate in resisting bending stress occurring when the foundation is unstable, such as on dredges, in marsh ground, etc. The cylinder liners are pressed into the bloc until the upper flange rests in a recess at the top of the frame. At the bottom of each liner there is a sealed slip joint, which permits elongation of the liner under working temperatures without distortion or cramping of the casting.

The trunk-type piston is used because of its simple design, accessibility, and the ease with which it may be effectively cooled in the larger sizes without complicated piping. A special close-grained iron is used, and all pistons are carefully machined and ground on all the surfaces.

Except those in the smaller-sized engines the pistons are of two sections. The upper section contains six narrow snap rings, while the lower section acts as a long crosshead to distribute the side thrust over a large cylinder surface, reducing the rate of liner wear.

The cylinder head is a one-piece, close-grained, gray-iron casting, with a flat bottom and top, and rests directly on top of the en bloc frame. The head design is such that a stream of cooling water is directed and plays continually upon the center of the cylinder area between the intake and exhaust valve and around the fuel valve, where the most intense heat is generated, while the engine is operated. This effective cooling of the cylinder head at this point eliminates the hot spot which is responsible for so many cylinder-head failures. The conducting pipe is shown in Fig. 2.

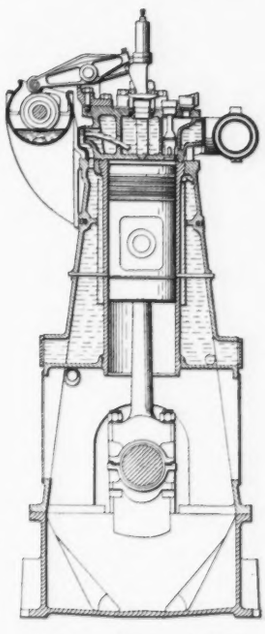


*Fig. 2—Cross-section, showing cylinder cooling*

A free and rapid circulation of cooling water is permitted by the large water spaces in the casting, effectively cooling all areas subjected to heat.

The air compressor is the standard supplied with all Fulton engines, and is direct-connected to the crankshaft.

The fuel spray valve will, on the larger units, have a lift and timing adjustment device under control of the governor. The fuel is delivered to the spray valves by a pump, the length of suction strokes of whose plungers is controlled by the governor.

## An Automatic Grease Cup

A grease cup that is compact, simple and effective has been developed and is being marketed by the Grease-ometer Corporation, 460 Montgomery St., San Francisco. It consists essentially of a piston mechanism actuated by a spring, and is provided with threaded ends to connect with a grease gun and a bearing opening, respectively. The grease, forced in under pressure, fills the container and compresses a spring, which causes a constant and regular supply of lubricant to the bearing, delivered through a metering tube of small bore.

An ingenious method of controlling the flow of grease has been devised: Brass pins with numbered, flattened heads are available, of varying thickness, marked from 1 to 10. One of these is inserted in the metering tube, with the flattened head inside the lubricator. If the discharge is still excessive, a metering pin marked with a lower number is substituted. The metering tube is easily removable, and changes are made in the size of the pin used until exact regulation is insured.

As the grease is absorbed by the bearing, the piston disappears into the

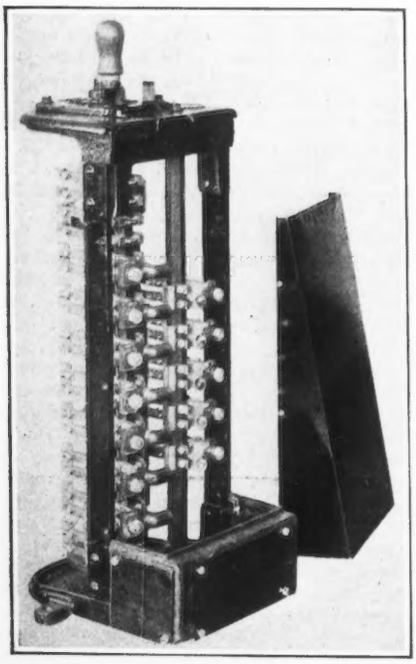
lubricator, and the necessity for an additional supply of lubricant is seen at a glance. There is only one movable part, the piston; and around the collar of the lubricator is a packing ring, which serves to exclude dust and dirt. The Grease-om-eter is easily cleaned after removing the metering tube. It is intended for application wherever a grease cup is now used.

## New Drum Controllers Introduced

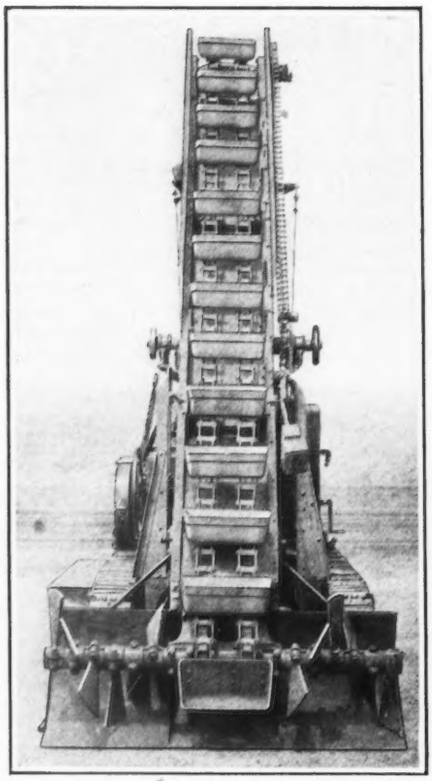
A new, completely standardized line of drum controllers embodying new features of construction and comprising units for general purpose, crane hoist, or machine-tool applications, for either direct or alternating current, has been announced by the General Electric Co. In each group several sizes have been provided to cover a wide range in motor ratings, the smaller sizes being suitable for wall mounting and those for larger motors, where floor mounting is necessary.

A number of distinctive advantages are claimed for the new line. One of the particular features is in the mechanical construction, a skeleton type of frame being used. This consists of a cast cap plate and base to which are hot-riveted rectangular steel bars, thus making it unnecessary for the back of the switch to function as a framework for holding the top and bottom of the switch together. As a result, the switch is accessible from both back and front for the purpose of making adjustments and renewals.

A desirable feature, said to be particularly valuable in crane service, is the interchangeability of operating handle mechanisms. A vertical operating lever or a spring return mechanism may easily be substituted for the horizontal lever with which the switch is equipped by using another dial plate. New style self-aligning contact fingers are used.



*Several improvements have been made in the new drum controller*



*Improved loader with feeder*

## Elevator Loader Improved

An improved crawler loader designed to handle around 140 tons per hour of coal or other crushed material has been announced recently by the Link Belt Co., Chicago.

The loader is made up of four units —the elevator, power plant, crawler and chassis. The controls for the operating units have been so arranged that the loader can readily be handled by one man. The starting, stopping and turning are controlled by two hand levers, which automatically apply brakes when stopping.

The buckets on the elevator are carried on double strands of malleable-iron and steel chains running on manganese-steel sprockets. The driving wheel on the elevator head shaft is provided with a safety breaking pin. The feeder for the elevator consists of manganese steel paddles bolted to a hexagonal steel shaft. The chassis on which the different units are carried is made of heavy angles, plates and channels riveted together.

The power plant of the loader is a 30-hp. gasoline unit running at 1,200 r.p.m. equipped with a governor. Where desired, an electric motor can be furnished in place of the gasoline engine. The drive from the engine or motor to the different units, through the operating gear, is by means of roller chains running on steel sprockets. The treads of the crawler are made of special heat-treated steel 11 in. wide, and the crawlers are so arranged that the loader can turn left or right when traveling in either direction.

All drives are protected by sheet-steel guards, and special attention has been given to the subject of lubrication of the parts.

## Trade Catalogs

**Loading and Unloading Equipment**—Two interesting and very handsome catalogs have been issued by the Demag Deutsche Maschinenfabrik A. G., of Duisburg, Germany. One of these, in English, is entitled "The Harbour" and consists of three parts: Part 1, Construction of Waterways and Harbour Basins, pages 1-74; Part 2, Loading, Discharging and Conveying Plant for the Rapid Handling of Cargo, pages 75-396; and Part 3, Installations for the Upkeep of Ports and Ships, pages 397-442. Hundreds of illustrations, with descriptive and instructive text, make the catalog an unusual production. The other catalog, entitled "Die Werft," is written in German, and deals with the erection and equipment of docks and dry-docks. Both are bound in stiff covers.

**Power Plant**—A condensed catalog (No. 26) of power-plant equipment has been issued by the Ernest E. Lee Co., of 115 South Dearborn St., Chicago, representatives in Illinois, Wisconsin, Indiana, and Iowa of various manufacturers of such equipment.

**Compressor**—The Independent Pneumatic Tool Co., 600 W. Jackson Boulevard, Chicago, Ill., has issued Bulletin P.C. 102, covering the "Thor VI" portable compressor outfits. The Thor VI portable gasoline-engine-driven compressor is equipped with the Rix supercharger.

**Furnace, Quicksilver**—The Gould improved rotary quicksilver furnace and condensing system, built to reduce all ores of quicksilver, is described in a folder issued by H. W. Gould, Mills Building, San Francisco, Calif., who is the designer and erector.

**Watthour Meters**—Bulletin No. 71 of the Sangamo Electric Co., Springfield, Ill., contains 19 pages of instructions and data regarding the use of the company's D-5 watthour meters.

**Shovel**—The Thew Shovel Co., Lorain, Ohio, has issued a 13-page pamphlet describing its Lorain 75 gasoline 1¼-cu.yd. shovel with caterpillar treads. The machine is light and compact.

**Valves**—Catalog No. 33 of the Homestead Valve Manufacturing Co., Homestead, Pa., covers the wide variety of valves made by that company, including a complete line of plug-type valves.

**Pyrometers**—Catalog No. 15 of the Brown Instrument Co., Philadelphia, Pa., contains information on the latest developments in pyrometry.

**Oil Engines** — "Direct-Injection Oil Engines for All Purposes" is the title of a new publication just issued by the Ingersoll-Rand Co., New York. An attractive cover printed in colors illustrates the title by portraying Ingersoll-Rand oil engines as applied to railway, marine, power-house, industrial, and building applications. The text consists of technical data and details of "PO" oil engines of 55-, 110- and 150-b. hp. sizes, and includes forty-two illustrations of plant layouts, installation views, diagrams, and engine details.

**Corrosion**—Bulletin 90 of the Pacific Foundry Co., of San Francisco, describes applications of high-silicon iron in pipes, fittings, and chemical apparatus.

# The Market Report

## Lead Bright Spot in Metal Markets

### Copper Selling Dull With Easing Price—Little Change in Zinc, Tin, and Silver

**New York, May 26, 1926**—Except for a brisk business in lead following the reduction in price to 7.65c., New York, last Friday, the week ending today has been a dull one for non-ferrous metals. Volume of copper sales was particularly small. Holidays in London, with the consequent absence of cable quotations, probably contributed to the lethargy, but domestic buyers are not much in evidence. Zinc has been steady, with nearly average business, and tin and silver have been quiet. Antimony broke to 9.50c. duty paid New York for spot and future positions. Minor metals are practically unchanged from prices obtaining last week.

### Daily Prices of Metals

| May | Copper N. Y. net refinery* | Tin | | Lead | | Zinc |
|---|---|---|---|---|---|---|
| | Electrolytic | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 20 | 13.60 | 58.50 | 60.50 | 7.75 | 7.50@7.55 | 6.85 |
| 21 | 13.55 | 58.50 | 60.50 | 7.65 | 7.45@7.50 | 6.85 |
| 22 | 13.60 | 58.25 | 60.25 | 7.65 | 7.45 | 6.825@6.85 |
| 24 | 13.60 | 58.25 | 60.25 | 7.65 | 7.45 | 6.825@6.85 |
| 25 | 13.60 | 58.50 | 61.00 | 7.65 | 7.425@7.45 | 6.85 |
| 26 | 13.55 | 58.50 | 61.00 | 7.65 | 7.425@7.45 | 6.85 |
| Av. | 13.583 | 58.417 | 60.583 | 7.667 | 7.463 | 6.846 |

The prices correspond to the following quotations for copper delivered: May 20th, 13.85c.; 21st, 13.80c.; 22d, 24th, 25th, 13.85c.; 26th, 13.80c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

### London

| May | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic | | | | | | |
| | Spot | 3M | | Spot | 3M | Spot | 3M | Spot | 3M |
| 20 | 56 1/4 | 57 1/8 | 64 1/2 | 267 1/4 | 265 | 28 7/16 | 28 15/16 | 32 1/8 | 32 1/2 |
| 21 | 56 1/4 | 57 1/8 | 64 1/4 | 266 3/4 | 265 1/4 | 28 9/16 | 29 1/16 | 32 1/8 | 32 5/8 |
| 24 | Holiday | ... | ... | ..... | ..... | ..... | ..... | ..... | ... |
| 25 | 56 1/4 | 57 1/8 | 64 1/4 | 268 3/4 | 268 1/4 | 28 9/16 | 29 1/16 | 32 1/8 | 32 9/16 |
| 26 | 56 1/4 | 57 1/8 | 64 1/4 | 268 | 268 | 28 7/16 | 28 7/8 | 32 1/16 | 32 7/16 |

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

### Silver, Gold, and Sterling Exchange

| May | Sterling Exchange "Checks" | Silver | | Gold London | May | Sterling Exchange "Checks" | Silver | | Gold London |
|---|---|---|---|---|---|---|---|---|---|
| | | New York | London | | | | New York | London | |
| 20 | 4.85 7/8 | 65 | 30 1/2 | 84s 9 3/4d | 24 | 4.85 3/4 | 64 7/8 | Holiday | ..... |
| 21 | 4.85 3/4 | 64 7/8 | 30 1/16 | 84s 9 3/4d | 25 | 4.85 3/4 | 64 3/4 | 29 15/16 | 84s 9 3/4d |
| 22 | 4.85 3/4 | 64 7/8 | 30 1/16 | ..... | 26 | 4.85 7/8 | 64 3/4 | 29 15/16 | 84s 10d |

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

### Copper Seems Easier

Though there is little quotable change in the price, copper seems easier today than a week ago. The only business reported today has been at 13.80c., delivered, but sales have been conspicuously few since Monday, and it is likely that some metal could be obtained at a concession from this price. The buying is mostly for June, and several sales have been made for immediate shipment. The indications are that stocks both of manufactured goods and of raw copper in the hands of fabricators are exceedingly small, and as producers have no great accumulation of metal at the refineries, they are confident that good business lies immediately ahead of them. If there is any slackening in consumption, it is for brass making rather than for any of the regular copper products.

### Lead Declines to 7.65c., New York

Though London prices advanced last Friday, May 21, the American Smelting & Refining Co. cut its contract price for New York lead on that day from 7.75 to 7.65c. The cut is said to have been made to stimulate business after two or three fairly quiet weeks during which smelter input continued extremely heavy. The reduction brought the New York price below the lowest level reached last year, which was on April 21 and 22, 1925, when the market was quoted at 7.65@7.75c., and after which it steadily rose. Buying has been much better since the reduction was made, both of the two principal sellers reporting an excellent business, chiefly for June shipment. Spot lead, and a small amount of chemical lead from the Middle West, have brought slightly more than the Smelting company's fixed price, though this represents the major volume of busines. In the Middle West, a small tonnage of lead sold on Monday as low as 7.40c., but this seems to have been below the market, most of the business during the last three days having been at 7.425@7.45c., St. Louis. The European market seems unusually quiet.

**Correction.**—The quotation for 3-months lead in London on May 7 published as £28 5s. 0d. in the issue of May 15 should have been £28 0s. 0d. The error arose in the transmission of the cabled message.

### Zinc Continues Steady

Virtually all of the moderate business in zinc was done at 6.85c. St. Louis, though one sale was made at 6.80c. and two small lots went for 6.825c. One large producer calls the market dull, whereas two others characterize it as tight and steady so far as prices are concerned. High-grade is quotable at 8c. to 8.25c. delivered in New York with the market quiet.

## Tin Quiet and Lower

Consumers have done little in the tin market during the last week, but there has been a moderate amount of trading among dealers. May Straits tin has varied between 60¼ and 61c., with August arrival about 2c. lower. The 99 per cent grade has been almost entirely neglected, and so dealers have been more than usually willing to cut prices in this grade.

## Silver Steady

Quotations for silver have fluctuated within narrow limits during the last week, the demand from India being at prices slightly under parity. The market appears steady at the close.

**Mexican Dollars** (Old Mexican Pesos): May 20th, 49⅜c.; 21st, 22nd and 24th, 49⅝c.; 25th and 26th, 49½c.

## Francs Improve

Francs have reacted above 3c. but have not shown much strength at the levels of the last two or three days. Closing cable quotations on Tuesday, May 25, were: francs, 3.225c.; lire, 3.8225c.; and marks, 23.81c. Canadian dollars, $\frac{1}{16}$ per cent premium.

## Other Metals

**Quotations cover large wholesale lots unless otherwise specified**

**Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £118 per long ton. Slackness on Continent adverse factor.**

**Antimony**—Per pound, duty paid, New York; Chinese brands, spot, 12.25@9.50c. June arrival, 9.50c. Cookson's "C" grade, spot, 20c. Market very dull and prices mostly nominal. Spot particularly weak.

**Bismuth—$2.70@$2.75 per lb., in ton lots. London, 10s.**

**Cadmium**—60c. per lb. Market good. London, 1s. 9d. for Australian metal.

**Iridium** — $160@$170 per oz. for 98@99 per cent. Nominal. London, £70@£75 for 99.5 per cent.

**Nickel**—Ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent). London, £170@£175 per long ton.

**Osmium—$80@$85 per ounce, nominal; London, £19@£22.**

**Palladium**—Refined, $67@$69 per oz. Crude, $60@$65 per oz. London, £14@£16¼, nominal.

**Platinum** — Per ounce refined, officially quoted: $108. Sales also at $104@$105. Crude, $102@$103. London, £22@£23½ for refined; crude, £21@£22.

The market for platinum and allied metals is weak as a result of slow buying by jewelry manufacturers. The trade does not apprehend any considerable supply from South Africa for several years, if at all.

**Quicksilver**—Per 75-lb. flask holding steady at $91.25. San Francisco, $90.83. London, £15@£15¼.

**Ruthenium** — $55@$65 per ounce; London, £13@£16.

**The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of May 8.**

## Metallic Ores

**Iron Ore**—Domestic, unchanged from prices in issue of May 8. Foreign f.o.b. cars, Atlantic ports, cents per unit:

Swedish and Norwegian, low-phosphorus, 68 per cent, 10¼@10⅜c.

Spanish low-phosphorus, 52@54 per cent, 10@11c.

Algerian, low-phosphorus, 9¼@9⅜c.

Spanish foundry or basic, 50@54 per cent, 8½@9½c.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

**Tungsten Ore**—Per unit of $WO_3$, N.Y.: Wolframite, $10.50@$10.60; Western scheelite, $10.75@$10.85. Domestic demand very light, and prices largely nominal.

**Vanadium Ore**—Containing 4 to 8 per cent $V_2O_5$, 30@35c. per pound of $V_2O_5$ f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent $V_2O_5$, 60@65c. per pound $V_2O_5$, duty paid, seaboard.

**Chrome Ore, Manganese Ore, Molybdenum, Tantalum, and Uranium are unchanged from quotations in the May 8 issue.**

## Zinc Blende Unchanged—Lead Ore Lower

**Joplin, Mo., May 22, 1926**

| Blende | Ton |
|---|---|
| High | $49.85 |
| Premium blende, basis 60 per cent zinc | $46.00@47.00 |
| Prime western, basis 60 per cent zinc | 45.00 |
| Fines and slimes, 60 per cent zinc | 44.00@42.00 |
| Average settling prices, all zinc | 45.10 |
| **Galena** | |
| High | $96.75 |
| Basis 80 per cent lead | 90.00 |
| Average settling price, all lead | 95.94 |

Shipments for the week: Blende, 12,518; lead, 1,103 tons. Value, all ores the week, $670,390.

Production has declined to 14,810 tons this week, 5,000 tons lower than the peak production in February. Necessity has caused a number of mines to close down and may cause others to close when a check on profit and loss is taken at the end of the month.

Lead prices were lowered $2.50 per ton, and one buyer reported that he had received an intimation that further reductions may be expected. There are reported some 12,000 tons of reserve stocks of lead ore held for better prices.

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**Platteville, Wis., May 22, 1926**

| Zinc Blende | Per Ton |
|---|---|
| Blende, basis 60 per cent zinc | $47.50 |
| **Lead Ore** | |
| Lead, basis 80 per cent lead | $92.50 |

Shipments for the week: Blende, 1,084 tons; lead, none. Shipments for the year: Blende, 20,998; lead, 512 tons. Shipments for the week to separating plants, 1,830 tons blende.

## Non-Metallic Minerals

**Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the May 8 issue.**

## Mineral Products

**Arsenious Oxide (White arsenic)**—3½c. per lb. Small lots sold. London, £15 per long ton.

**Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the May 8 issue.**

## Ferro-Alloys

**Ferromanganese** — Domestic, 78@82 per cent, $88@$99 per gross ton furnace; prompt and future.

**Ferrosilicon**—14 to 16 per cent, $42@$47 per gross ton, f.o.b. works; 50 per cent, $87.50 delivered in carload lots; 75 per cent, $145. Market active.

**Ferrotungsten** — $1.05@$1.10 per pound contained W, f.o.b. works according to grade.

**Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrotitanium, Ferrouranium, Ferrovanadium, and Spiegeleisen are unchanged from prices in the May 8 issue.**

## Metal Products

**Rolled Copper** — Sheets, 22½c.; wire, base price, 16c. per lb.

**Zinc Sheets** — 11.25c. per lb., f.o.b. works.

**Lead Sheets, Nickel Silver, and Yellow Metal are unchanged from prices in the May 8 issue.**

## Refractories

**Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the May 8 issue.**

## Steel Steady—Pig Iron and Coke Quiet

**Pittsburgh, May 25, 1926**

Steel-mill operations are holding up better than was expected, and chiefly, it seems, because expectations were based upon decreases that occurred at this time in each of the last three years. There does not seem to have been any decrease in the last two or three weeks, but rather a slight increase last week, the general rate holding above 80 per cent.

Bookings in fabricated structural steel and in fabricated plate hold up well. At 118,385 net tons booked, fabricated plate for the first four months of this year make the best showing for the first four months of any year since 1923. Freight-car buying, on the other hand, has been practically absent for more than two months.

Sheet demand has not borne out the slightly more favorable showing it made a week ago and in general is rather poor, with somewhat lower prices in galvanized, at 4.35c. to 4.50c. Automobile sheets are now 4.30c. flat, against 4.30c. to 4.40c.

**Pig Iron**—Pig iron continues quiet in general. Prices remain: Bessemer, $19.50; basic, $18.50; foundry, $19, f.o.b. Valley furnaces.

**Connellsville Coke.**—The spot market is slightly easier. Spot furnace, $2.85@$3; spot foundry, $4@$4.50.

# Company Reports

## Lower Earnings for Nevada Consolidated

Production by the Nevada Consolidated Copper Co. for the quarter ended March 31, 1926, is given herewith in comparison with that of the preceding quarterly period:

| | Pounds Copper | Monthly Average |
|---|---|---|
| 1926—Quarter ended March 31 | 19,548,813 | 6,516,271 |
| 1925—Quarter ended Dec. 31 | 19,555,262 | 6,518,421 |

A total of 704,956 tons dry weight of Nevada Consolidated ore, averaging 1.30 per cent copper, was milled. Ruth mine direct-smelting ore amounting to 5,972 tons, of an average grade of 3.67 per cent copper, was shipped to the smelter. There was also treated at the concentrator, in addition to the ores milled, 331,950 tons dry weight of pit strippings, of 0.68 per cent average copper content. No custom ore was treated during the quarter.

The average recovery at the concentrator was 92.01 per cent of the copper contained in the Nevada Consolidated ore, or 23.96 lbs. of copper per ton of ore milled, compared with an average recovery of 91.99 per cent or 27.01 lbs. of copper per ton of ore averaging 1.47 per cent copper, treated during the preceding quarterly period. The milling of pit strippings resulted in an average recovery of 82.14 per cent, corresponding to 11.22 lbs. of copper per ton of this material treated, compared with a recovery of 81.22 per cent, or 11.18 lbs. of copper per ton milled during the previous quarter. The cost of treating this low-grade material, the copper content of which exists in the form of sulphides, averaged 10.11c. per net pound of copper recovered, this cost including due proportion of charges for depreciation and fixed and general expenses and of credits for precious metals and miscellaneous earnings.

The cost per net pound of copper produced from all sources, including charges for depreciation of plant and equipment and all fixed and general expenses, and after crediting gold and silver and miscellaneous earnings, was 10.50c. compared with a cost of 10.15c. per pound, similarly computed, for the previous quarter.

The financial outcome of operations is exhibited in the statement below, set out in comparison with the results of the quarter ended Dec. 31, 1925:

| | First Quarter 1926 | Fourth Quarter 1925 |
|---|---|---|
| Operating gain from copper production | $627,041.90 | $683,870.11 |
| Gold and silver and miscellaneous earnings | 219,165.95 | 290,768.46 |
| Nevada Northern Railway Co. dividend | 75,000.00 | 75,000.00 |
| Total income | $921,207.85 | $1,049,638.57 |
| Plant and equipment depreciation | 172,662.42 | 167,862.51 |
| To surplus | $748,545.43 | $881,776.06 |

## Mohawk Mining Co.

Following are data from the annual report of the Mohawk Mining Co., operating in the Michigan copper country, for 1925:

| | | |
|---|---|---|
| Sales | | |
| 17,143,512 lb. of copper at 14.56935c. per pound | | $2,497,698.30 |
| Cost of sales | | |
| Copper on hand Jan. 1, 1925 | $204,842.52 | |
| Operating expenses at mines | 1,335,057.78 | |
| Smelting, freight and New York expenses | 278,316.21 | |
| Taxes | 54,673.80 | |
| | $1,872,890.31 | |
| Less—copper on hand Dec. 31, 1925 at cost | 110,805.15 | |
| Net cost of copper sold | | 1,762,085.16 |
| Profit on sales of copper | | $735,613.14 |
| Miscellaneous income | | |
| Interest and dividends | $26,150.92 | |
| Rents | 42,881.84 | |
| | | 69,032.76 |
| Profit for the year before providing for depreciation and depletion | | $804,645.90 |
| Add appreciation realized during the year | | 469,412.22 |
| | | $1,274,058.12 |
| Deduct | | |
| Depletion | $578,009.55 | |
| Depreciation | 90,219.90 | |
| | | 668,229.45 |
| Net profit | | $605,828.67 |

### Summary of Results for the Year

| | |
|---|---|
| Rock hoisted, tons | 701,335 |
| Rock stamped, tons | 683,732 |
| Product of mineral, pounds | 23,495,000 |
| Product of refined copper, pounds | 16,394,006 |
| Yield of rock treated per ton, pounds | 23.977 |
| Cost per ton of rock hoisted | $1.904 |
| Cost per ton of rock stamped | $1.953 |
| Total operating cost per pound of refined copper, cents | 8.147 |
| Cost of taxes, cents | 0.333 |
| Cost of smelting, freight and marketing product, including eastern offices' expenses, cents | 1.698 |
| | cts. 10.178 |

The balance sheet as of Dec. 31, 1925, shows current assets of $1,758,567, against current liabilities amounting to $118,900.

The present underground force at the Mohawk mine is 83 per cent of normal, compared with 70 per cent for the year 1924. A large pumping station is under construction on the 24th level north of No. 6 shaft. Expenses on surface were increased somewhat at the mine by building a fireproof steel-and-concrete change house at No. 6 shaft to accommodate 265 men, completely equipped for 200 men. The Mohawk mill operated at 80 per cent of its capacity. The company has continued reconstruction of the concentrating department of the Mohawk mill.

## Big Gain for Greene Cananea

The net profit of the Greene Cananea Copper Co. for the year 1925 amounted to $589,952.13, and a further sum of $416,414.56 was received from the Federal Government for refund of taxes overpaid in previous years and from claims against the Mexican Government collected during the year, resulting in a total cash gain for the year of $1,006,366.69 according to the recent annual report.

The company produced during the year: 30,535,646 lbs. of copper, 405,998 oz. of silver, and 2,177 oz. of gold. Cost of fine copper including depreciation and all charges except depletion, was 11.9047c. per pound, a reduction of 1.1491c. per pound over the previous year's cost of 13.0538c. The price received for refined copper in the period covered by the report was 14.2069c.

### Combined Income Account for the Year Ended Dec. 31, 1925

| | | |
|---|---|---|
| Income | | |
| Sales of metals | | $4,322,461.21 |
| Miscellaneous receipts | | 101,656.83 |
| | | $4,424,118.04 |
| Expense | | |
| Mining and reduction | $3,220,076.52 | |
| Refining and selling | 598,256.19 | |
| Administration and U. S. Federal taxes | 97,830.31 | |
| Metals in process and on hand at beginning of year | 660,340.74 | |
| | $4,576,503.76 | |
| Metals in process and on hand at end of year | 1,076,026.83 | 3,500,476.93 |
| | | $923,641.11 |
| Depreciation and replacements of buildings and equipment | | 347,347.24 |
| | | $576,293.87 |
| Interest paid | | 5,461.73 |
| | | $570,832.14 |
| Income from investments | | 19,119.99 |
| Balance, net income of the year, carried to balance sheet | | $589,952.13 |

This compares with a net income of $56,122 for 1924.

There were smelted 224,763 dry tons of new copper-bearing material from all sources at a smelting cost of $3.061 per ton. The average cost of mining copper ore was $2.7417 per ton for 737,543 tons.

The following shows results at the concentrator for the year:

| | |
|---|---|
| Dry tons treated | 538,345 |
| Per cent copper in heads | 1.89 |
| Per cent copper in concentrates | 15.96 |
| Per cent copper in tails | .17 |
| Per cent recovery | 92.20 |
| Ratio of concentration | 9.143:1 |
| Cost per ton of ore concentrated | $0.917 |

## Belmont Surf Inlet Mines, Ltd.

Operations of the Belmont Surf Inlet Mines, operating in British Columbia, during 1925 gave the following financial returns:

| | | |
|---|---|---|
| **Credits** | | |
| Values realized | | $713,951.70 |
| **Debits** | | |
| Mining | $208,737.66 | |
| Milling | 95,423.33 | |
| Loading | 12,116.39 | |
| | | $316,277.38 |
| | | $397,674.32 |
| | | 9,359.00 |
| Miscellaneous income | | $407,033.32 |
| Loss on conduct of | | |
| Hospital | $3,155.99 | |
| Bunkhouse | 8,268.51 | |
| Mess house | 9,837.65 | |
| School | 18.87 | |
| Employees' club | 1,201.02 | |
| | $22,482.04 | |
| Less—rents and discounts | 4,631.97 | |
| | $17,850.07 | |
| Administration expenses | 6,611.99 | |
| | | 24,462.06 |
| Operating profit for the year 1925 | | $382.571.26 |
| Depreciation | | |
| Mill, buildings, machinery and tug | $85,857.03 | |
| Exploration | 604.20 | |
| Reserve for mineral tax | 12,326.60 | |
| | | 98,787.83 |
| Net profit for the year 1925 | | $283.783.43 |

The gross metal content of the 78,640 dry tons of ore milled during the year amounted to 39,648.190 oz. of gold, 22,778.39 oz. of silver, and 677,422 lb. of copper. With gold calculated at $20.6718 per ounce, silver at $0.6915 per ounce, and copper at $0.1433 per pound, the gross value of this tonnage was $932,411.76, equivalent to a per-ton value at the above prices of $11.857. Concentration of this ore was effected at a ratio of 12 into 1.

## Hardy Foresees Possible Famine of Tungsten Ore Following Price Decline

The tungsten market has of late experienced a very unhealthy reaction—"unhealthy" because the market price has been reduced continuously without such reduction having induced any business, according to Charles Hardy, New York metal dealer. Buyers have for the time being withdrawn from the market, having put in considerable supplies to meet the requirements for several months ahead. If a reduction in price would bring about business, such reduction would be certainly justified. If, however, the reduction is made to induce buyers to buy, it has, as a rule, an opposite effect, and buyers seeing a dropping market continue to bide their time before making further purchases.

Continuously declining prices have had a double effect; on the one hand, they have stopped all business on the part of the consumer here as well as abroad; on the other hand, they have curtailed production, and mines planning to resume operations have not done so; and Bolivia, Burma, New Zealand, and Australia have not contributed anything to speak of to the world's visible supply.

Production in the United States has not reached the figures for which it was credited, and though during 1925 and 1926 consumers could draw upon stocks—which like those in England were still available from the days of the war—those stocks have been very heavily reduced, and will no longer form a factor in considering stocks, production, and consumption figures.

Assuming that the consumption in every consuming country of the world is below normal during the year 1926—even below pre-war consumption of 8,000 tons a year—it is difficult to see, says Mr. Hardy, at this writing, the sources where such limited consumption is to come from, and the lower the figures now quoted for tungsten ore, the more serious will be the reaction when, after their absorption of stocks, buyers will have to come into the market to meet requirements. In view of the uncertainty in China, now the main provider of tungsten, and the distance of the producing country to the consuming countries, it is dangerous to leave the replacement of tungsten ores to the moment of necessity, and unless a far-sighted policy is followed, tungsten, like antimony, will experience a feast or a famine.

## Sharpe Sees Zinc Recovery Postponed

According to A. J. M. Sharpe, foreign correspondent for the American Zinc Institute, the effect of the British strike was to reduce the May consumption of zinc by at least 5,000 tons, which means that amount of metal swelling the Continental surplus at the end of May. "Consequently," he says, "the zinc market cannot enjoy much of an advance, as Continental sellers would take advantage of any uptrend to ease their stocks, and if the United States stocks register an increase of 5,000 tons, the period when a permanent recovery in the world situation of zinc may be expected must be further postponed. If the April figures from the United States register the gain predicted, then a more serious effort will be made to bring about a much-needed further curtailment of both ore and metal production."

**Estimated Stores on May 1, 1926**

| | Metric Tons |
|---|---|
| United States | 23,600 |
| Canada | 2,200 |
| Australia (including unsold shipments afloat) | 2,200 |
| Germany and Poland | 7,500 |
| Belgium | 2,600 |
| France | 1,000 |
| Great Britain | 1,800 |
| Scandinavia | 200 |
| Far East | 500 |
| Elsewhere | 1,500 |
| Total | 43,100 |

## Mining Dividends Increase in May

The following dividends were paid by American mining and metallurgical companies in May, 1926:

| Companies in the United States | Situation | Per Share | Total |
|---|---|---|---|
| American Smelting & Refining | Various | $1.75 Q | $1,067,465 |
| Anaconda Copper Mining | Various | .75 Q | 2,250,000 |
| Betty O'Neal Mines, s | Nev. | .15 Q | 66,139 |
| Chief Consolidated, l, s | Utah | .10 Q | 113,870 |
| Colorado Fuel & Iron, pfd | Various | 2.00 Q | 40,000 |
| General Development | Various | .25 Q | 30,000 |
| Gladstone Mountain, l | Wash. | .005 M | 6,609 |
| Homestake Mining, g | S. D. | .50 M | 125,580 |
| International Nickel, pfd., n, c | Ont., W. Va. | 1.50 Q | 133,689 |
| Miami Copper | Ariz. | .25 Q | 186,778 |
| New Cornelia Copper | Ariz. | .40 Q | 720,000 |
| New Jersey Zinc | Various | 2.00 Q | 981,632 |
| St. Mary's Mineral Land, c | Mich. | 2.00 A | 320,000 |
| U. S. Steel, pfd | Various | 1.75 Q | 6,304,919 |
| United Verde Copper | Ariz. | 2.00 Q | 600,000 |
| United Verde Extension, c | Ariz. | .75 Q | 787,500 |
| Vanadium Corporation | Colo., Peru | .75 Q | 283,775 |
| Companies in other countries | | | |
| Amparo Mining, g, s | Jalisco | .02 Q | 40,000 |
| Aramayo Mines, s, t, b, c | Bolivia | Sw.fr.1.25 | fr.1,050,000 |
| Cerro de Pasco, c, s | Peru | $1.00 Q | $1,122,842 |
| Great National Mexican Smelting | Mexico | 20.00 | ..... |
| Hollinger Consolidated Gold | Ont. | .08 4 wks. | 393,600 |
| St. John del Rey, pfd., g | Brazil | ls. 8d. | £8,333 |
| Total | | | $15,574,398 |

s, silver; l, lead; g, gold; n, nickel; c, copper; t, tin; b, bismuth; Q, quarterly; M, monthly; A, annually; Sw.fr., Swiss francs.

The total of dividends paid in May was about $1,000,000 greater than for the previous corresponding quarter, in February, and also about the same amount greater than for the same month in 1925. Apparently the slight slump in metal prices in the last four or five months has had no effect on the generosity of the boards of the mining companies so far. New Cornelia Copper again increased its dividend, this time to 40c. per share, compared with 30c. in February and 25c. last November. Vanadium Corporation also paid an enlarged dividend, 50 per cent greater than last February. St. Mary's Mineral Land, which makes distributions annually only, paid $2 instead of $3, the payment made a year ago.

**Dividend Yields**

The dividend yields on the stocks of the above companies that are on a regular dividend basis and are traded in, based on the May distributions and on recent market prices, are as follows:

| Company | Per Cent Annual Yield | Company | Per Cent Annual Yield |
|---|---|---|---|
| Gladstone | 19.4 | Anaconda Copper | 6.6 |
| Chief Consolidated | 13.6 | Cerro de Pasco | 6.4 |
| Homestake | 11.0 | A. S. & R. | 6.0 |
| United Verde Ex | 10.9 | International Nickel, pfd. | 5.8 |
| Vanadium Corp. | 8.7 | Hollinger Consolidated | 5.5 |
| Miami Copper | 8.6 | U. S. Steel, pfd. | 5.5 |
| New Cornelia | 8.2 | New Jersey Zinc | 3.8 |
| Colorado Fuel, pfd. | 7.4 | | |
| St. Mary's M. L. | 7.0 | Average | 8.4 |

# Current Prices of Mining Supplies

## Rise and Fall of the Market

PRICES have advanced during the past month in cast-iron pipe, Western fir timbers and linseed oil. Mill quotations on steel sheets, particularly blue annealed and galvanized, are down about 10c. per 100 lb. from the April level; similar declines are reported in shapes and plates. Pine dimension and timbers appear lacking in price firmness; some of the minor items such as rope, are weaker than a month ago.

**SHEETS**—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

| | Pittsburgh, Large Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| Blue Annealed No. 10 | $2.40@$2.50 | $3.60 | $3.50 | $3.75 | $3.89 |
| Black No. 28 | 3.25@3.35 | 4.60 | 4.10 | 4.75 | 4.50 |
| Galvanized No. 28 | 4.50@4.60 | 5.70 | 5.25 | 6.00 | 5.65 |

**STEEL RAILS**—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

| | Pittsburgh Current | Pittsburgh One Year Ago | Birmingham | Chicago |
|---|---|---|---|---|
| Standard bessemer rails | $43.00 | $43.00 | $43.00 | $43.00 |
| Standard openhearth rails | 43.00 | 43.00 | 43.00 | 43.00 |

**TRACK SUPPLIES**—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

| | Pittsburgh Current | Pittsburgh One Year Ago | Chicago | St. Louis | San Francisco | Birmingham |
|---|---|---|---|---|---|---|
| Standard spikes, ⅜-in. and larger | $2.80 | $2.80 | $3.55 | $3.65 | $4.35 | $3.00 |
| Track bolts | 3.90@4.15 | 3.90@4.25 | 4.55 | 4.00 | 5.85 | 3.90 |
| Standard section angle bars | 2.75 | 2.75 | 3.40 | 3.25@3.75 | 4.00 | 4.15 |

**STRUCTURAL MATERIAL**—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

| | Pittsburgh, Mill | Birmingham Mill | New York | Dallas | St. Louis | Chicago | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | $1.80@1.90 | $2.05 | $3.34 | $4.15 | $3.25 | $3.10 | $3.30 |
| Channel, 3 to 15 in. | 1.80@1.90 | 2.10 | 3.34 | 4.15 | 3.25 | 3.10 | 3.30 |
| Angles, 3 to 6 in., ¼ in. thick | 1.80@1.90 | 2.10 | 3.34 | 4.15 | 3.25 | 3.10 | 3.30 |
| Tees, 3 in. and larger. | 1.80@1.90 | 2.10 | 3.34 | 4.15 | 3.35 | 3.10 | 3.30 |
| Plates | 1.80@1.90 | 2.00 | 3.34 | 4.15 | 3.25 | 3.10 | 3.30 |

**WIRE ROPE**—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

| | |
|---|---|
| Cast steel round strand rope | 20% |
| Galvanized steel rigging and guy rope | 7½% |
| Round strand iron and iron tiller | 5% |
| Plow steel round strand rope | 35% |
| Special steel round strand rope | 30% |
| Galvanized iron rigging and guy rope | +12½% |

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Drill Rod (from list) | 60@65% | 55% | 50% |

**WROUGHT PIPE**—The following discounts are to jobbers for carload lots at Pittsburgh mill:

| | Steel Inches | Steel Black | Steel Galv. | Iron Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|---|
| BUTT WELD | ⅛ to 3 | 62 | 50½ | 1 to 1½ | 30 | 13 |
| LAP WELD | 2½ to 6 | 59 | 47½ | 3 to 6 | 28 | 13 |

**STEEL PIPE**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black New York | Black Chicago | Black St. Louis |
|---|---|---|---|
| 2½ to 6 in. lap welded | 48% | 55% | 46% |

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | New York Current | New York One Year Ago | Birmingham | Chicago | St. Louis | San Francisco |
|---|---|---|---|---|---|---|
| 6 in. and over | $51.60@53.60 | $52.60@53.60 | $41.00 @ 42.00 base | $49.20@50.20 | $47.50 | $52.00 |

**NUTS**—Semi-finished, ½x½-in., 2c. each. Discount 70% for ⅝-in. and smaller; 65% for ¾-in. and larger. Case hardened, 6c. each, less 50%.

**HOLLOW TILE**—Price per block in carload lots to contractor for hollow building tile.

| | New York Current on Trucks | New York One Year Ago | Chicago | Philadelphia | St. Louis | San Francisco | Perth Amboy N. J., Factory |
|---|---|---|---|---|---|---|---|
| 4x12x12 | $0.1112 | $0.1162 | $0.075 | $0.12 | $0.07 | $0.108 | ..... |
| 6x12x12 | .1667 | .1743 | .096 | ..... | .094 | .156 | $0.252* |
| 8x12x12 | .2084 | .2179 | .135 | .22 | .128 | .244 | .312† |

* 10x12x12; † 12x12x12.

**MACHINE BOLTS**—½x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%.

**LUMBER**—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers at yards in San Francisco. To contractors, $2 per M. ft. additional.

| | 6-8 and 12 Ft. | 10-16-18 and 20 Ft. | 22 and 24 Ft. | 25 to 32 Ft |
|---|---|---|---|---|
| 3x3 and 4 | $26.00 | $27.00 | $28.00 | $31.00 |
| 3x6 and 8 | 26.00 | 27.00 | 28.00 | 31.00 |
| 4x4-6 and 8 | 26.00 | 27.00 | 28.00 | 31.00 |

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

| | New York 20 Ft. and Under | New York 22-24 Ft. | Chicago Up to 20 Ft., Pine | Chicago Up to 32 Ft., Fir |
|---|---|---|---|---|
| 3x4 to 8x8 | $43.00 | $44.00 | $42.50 | $41.00 |
| 3x10 to 10x10 | 50.00 | 51.00 | 47.50 | 41.00 |
| 3x12 to 12x12 | 57.00 | 58.00 | 57.50 | 41.00 |

| Other Cities | 8 x8-In. x 20 Ft. and Under Pine | Fir* | Hemlock | Spruce | 12 x 12-In. 20 Ft. and Under Pine | Fir* |
|---|---|---|---|---|---|---|
| Boston | $51.00 | $48.50† | $51.00 | $50.50 | $60.50 | $58.50† |
| Cincinnati | 37.00 | 73.00 | 73.00 | 85.00 | 48.00 | 77.00 |
| Denver | ..... | 34.75 | 34.75 | 34.75 | ..... | 34.75 |
| Minneapolis | 42.00 | 38.75 | 35.00 | ..... | 44.00 | 39.25 |
| Kansas City, Mo. | 29.00 | 22.00 | ..... | ..... | 44.00 | 21.00 |
| Philadelphia | 54.00 | 36.00 | 38.00 | 45.00 | 65.00 | 36.00 |

*Douglas fir. † Prime.

**NAILS**—The following quotations are per keg from warehouse:

| | Pittsburgh, Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2.65 | $3.05 | $3.75 | $4.28 | $2.93 | $4.95 |
| Cut | 2.80 | .... | 5.00 | 5.00 | 3.15 | 5.00 |

**PORTLAND CEMENT**—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

| | Current | One Month Ago | One Year Ago |
|---|---|---|---|
| New York, del. by truck | $2.50@2.60 | $2.50 | $2.50@2.60 |
| Chicago, f.o.b. | 2.10 | 2.10 | 2.20 |
| Cleveland, f.o.b. | 2.29 | 2.29 | 2.39 |

**LIME**—Warehouse prices:

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per Barrel 280-lb. net Finishing | Lump, per Barrel 280-lb. net Common |
|---|---|---|---|---|
| New York | $18.20 | $12.@13.10 | $3.50 | $2.25@$2.75 |
| Chicago | 20.00 | 18.00 | .... | 2.25 |

**LINSEED OIL**—These prices are per gallon:

| | New York Currant | New York One Year Ago | Chicago Current | Chicago One Year Ago |
|---|---|---|---|---|
| Raw in barrel (5 bbl. lots) | $0.84 | $1.07 | $0.87 | $1.26 |

**WHITE AND RED LEAD**—In 100-lb. kegs, base price in cents per pound:

| | Dry Current | Dry 1 Yr. Ago | In Oil Current | In Oil 1 Yr. Ago |
|---|---|---|---|---|
| Red | 15.25 | 15.75 | 16.75 | 17.25 |
| White | 15.25 | 15.75 | 15.25 | 15.75 |

**HOSE**—Quotations at New York warehouses:

Fire Protection 50-Ft. Lengths

Underwriters' 2½-in. coupled, single jacket (net) ..... 74c per ft.

Air—Best Grade

¾-in., per ft. ..... 3 ply $0.37½ 4 ply ..... $0.46

Steam—Discounts from List

First grade ..... 30–10% Second grade ..... 40% Third grade ... 40–10%

**RUBBER BELTING**—List price 6-in., 6 ply, $1.83 per lin.ft. for rubber transmission belting.

Best grade ..... 50% Second grade ..... 50–10%

**LEATHER BELTING**—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses:

| Grade | Discount from list |
|---|---|
| Medium | 40–5% |
| Heavy | 30–10% |

**RAWHIDE LACING**—For cut, best grade, 50%, 2nd grade, 60%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 50%; sides, 41c. per sq.ft.

**PACKING**—Prices per pound:

| | |
|---|---|
| Rubber and duck for low-pressure steam, ⅛ in. | $1.05 |
| Rubber sheet | .60 |
| Rubber sheet. wire insertion | .85 |

**MANILA ROPE**—Per lb., ¾-in. and larger, 1,200-ft. coils.

| | | | |
|---|---|---|---|
| Atlanta | $0.27 | New Orleans | $0.25½ |
| New York | .26 | Seattle | .24 |
| Chicago | .25½ | San Francisco | .25 |

**EXPLOSIVES**—Prices per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | $0.26 | $0.2875 |
| Minneapolis | .191/ | .2123 |
| Denver | .2025 | .2275 |
| Seattle | .165 | .19 |
| Cincinnati | .22 | .245 |
| New Orleans | .233 | .26 |
| San Francisco | .1625 | .1925 |

**FLOTATION OIL**—

Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York, carload lots, per gal. ..... $0.45

**CHEMICALS**—

| | |
|---|---|
| Zinc dust, 550 lb. casks, f.o.b. works, per lb. | $0.09@.10 |
| Litharge, f.o.b. New York, kegs, per 100 lb. | 15.25 |
| Sodium cyanide, 220 lb. single case lots, f.o.b. works, per lb. | 18@.22 |
| Calcium carbide, in drums, f.o.b. works, per lb. | .05½@.06 |

# Mining Stocks—Week Ended May 22, 1926

| Stock | Exch. | High | Low | Last | Last Div. |
|---|---|---|---|---|---|
| **COPPER** | | | | | |
| Anaconda | New York | 45⅝ | 44½ | 45 | Ap.17, My.24 0.75 |
| Arcadian Consol. | Boston | *85 | *70 | *70 | |
| Ariz. Com'l | Boston | 9⅞ | 9⅜ | 9⅞ | Jy.21, Jy. 31 SA 0.50 |
| Calaveras | N. Y. Curb | 1½ | 1½ | 1½ | |
| Calumet & Arizona | New York | 60⅝ | 58 | 59½ | Jn. 4, Jn. 21 Q 1.50 |
| Calumet & Hecla | Boston | 15 | 14⅝ | 14⅞ | Jn. 1, Jn. 15 Q 0.50 |
| Cerro de Pasco | New York | 63½ | 62 | 63¼ | Ap. 15, My. 1, Q 1.00 |
| Chile Copper | New York | 33 | 32½ | 32⅝ | Jn.2, Jn.28, Q 0.62½ |
| Chino | New York | 20½ | 20½ | 20½ | Sept., 1920 0.37½ |
| Con. Coppermines | N. Y. Curb | 3⅛ | 2¾ | 2⅞ | |
| Copper Range | Boston | 14 | 13 | 13⅜ | May, 1925 1.00 |
| Crystal Copper | Boston Curb | *32 | *27 | *28 | |
| East Butte | Boston | 3 | 2⅜ | 3 | Dec., 1919 0.50 |
| First National | Boston Curb | *18 | *15 | *17 | Feb., 1919 0.15 |
| Franklin | Boston | *50 | *35 | *35 | |
| Granby Consol. | New York | 19 | 18 | 19 | May, 1919 1.25 |
| Greene-Cananea | New York | 10½ | 10 | 10½ | Nov., 1920 0.50 |
| Hancock | Boston | | | *50 | |
| Howe Sound | New York | 33 | 32 | 32½ | Ap.1, Ap.15 0.75 |
| Inspiration Consl. | New York | 22 | 21⅝ | 21⅞ | Mar.18, Ap.5,Q 0.50 |
| Iron Cap | Boston Curb | 3⅝ | 3½ | 3½ | Jn. 1, Jn. 15 0.50 |
| Isle Royale | Boston | 10¼ | 10 | 10¼ | Jn. 1, Jn. 15 0.50 |
| Jerome Verde Dev. | N. Y. Curb | *55 | *55 | *55 | |
| Kennecott | New York | 53⅜ | 52⅜ | 53⅜ | Jn. 4, July 1 Q 1.00 |
| Lake Copper | Boston | 1 | *75 | *75 | June, 1925 0.50 |
| Magma Copper | New York | 36⅞ | 35⅞ | 36⅞ | Mh.31, Ap.15, Q 0.75 |
| Mason Valley | N. Y. Curb | 1⅞ | 1⅝ | 1⅞ | |
| Mass Consolidated | Boston | *30 | *25 | *25 | Nov., 1917 1.00 |
| Miami Copper | New York | 11⅜ | 11⅛ | 11⅛ | My.1, My.15Q 0.25 |
| Mohawk | Boston | 31⅞ | 30½ | 31⅞ | My.1, Je.1 Q 1.00 |
| Mother Lode Coa. | New York | 6⅛ | 6 | 6 | De. 11, De. 31 0.37½ |
| Nevada Consol. | New York | 12⅜ | 12 | 12 | Mh.18, Mh.31Q 0.25 |
| New Cornelia | Boston | 19⅞ | 18½ | 19⅞ | My.7, M.24 Q 0.40 |
| North Butte | Boston | 2⅜ | 2¼ | 2⅜ | Oct., 1918 0.25 |
| Ohio Copper | N. Y. Curb | *62 | *56 | *62 | No. 14, De. 2 0.05 |
| Old Dominion | Boston | 15 | 15 | 15 | Dec., 1918 1.00 |
| Phelps Dodge | Open Mar. | †126 | †122 | | Mar.20, Apr.20Q 1.00 |
| Quincy | Boston | 18¼ | 17½ | 17⅞ | Mar., 1920 1.00 |
| Ray Consolidated | New York | 12⅜ | 12 | 12⅛ | Ap.20, Ap.30 0.25 |
| Ray Hercules | N. Y. Curb | | | 11⅞ | |
| St. Mary's Min. Ld. | Boston | 27 | 26½ | 27 | Ap.17, My.18 2.00 |
| Seneca Copper | New York | | | 5½ | |
| Shannon | Boston | *40 | *35 | *40 | Nov., 1917 0.25 |
| Superior & Boston | Boston | *95 | *90 | *90 | |
| Tenn. C. & C. | New York | 11⅞ | 11⅛ | 11⅛ | My. 29, Ju.15, Q 0.25 |
| United Verde Ex. | N. Y. Curb | 28 | 27½ | 28 | Ap.6, My.1, 0.75 |
| Utah Copper | New York | 98 | 98 | 98 | Mh.18, Mh.31, Q 1.25 |
| Utah Metal & T | Boston | 1⅛ | 1 7/16 | 1⅛ | Dec., 1917 0.30 |
| Victoria | Boston | | | *50 | |
| Walker Mining | Salt Lake | *43 | *42 | *43 | |
| **NICKEL-COPPER** | | | | | |
| Internat. Nickel | New York | 34¼ | 33½ | 34 | My.11, My.31, Q 0.50 |
| Internat. Nickel, pfd. | New York | 104 | 104 | 104 | Ap.15, My.1, Q 1.50 |
| **LEAD** | | | | | |
| Gladstone M. M. Co. | Spokane | *31½ | *31 | *31 | Ja. 1, Ja. 10 M 0.01½ |
| National Lead | New York | 145½ | 142¼ | 142¼ | Jn. 11, Jn. 30 Q 2.00 |
| National Lead pfd. | New York | 120 | 119 | 119¼ | My.21, Je.15 Q 1.75 |
| St. Joseph Lead | New York | 38 | 37 | 38 | Jc.10, Je. 21 QX 0.75 |
| **ZINC** | | | | | |
| Am. Z. L. & S | New York | 7⅛ | 5⅞ | 6⅛ | May., 1920 1.00 |
| Am. Z. L. & S, pfd. | New York | 26¼ | 20 | 25 | Nov., 1920 1.50 |
| Butte C. & Z | New York | 4⅞ | 4⅞ | 4⅞ | De.10, De.24 0.50 |
| Butte & Superior | New York | 11 | 7⅞ | 9⅛ | Ma.15, Ma.31Q 0.50 |
| Callahan Zn-Ld | New York | 1⅜ | 1⅛ | 1⅜ | Dec., 1920 0.50 |
| Eagle Picher | Cincinnati | 27⅛ | 26⅛ | 26⅛ | My. 15, Jn.1 0.40 |
| Eagle Picher, pfd. | Cincinnati | | | 113 | Mh.31, Ap.15Q 1.50 |
| New Jersey Zn. | N. Y. Curb | | | 208 | Ap.20, My.10Q 2.00 |
| United Zinc | N. Y. Curb | | | *70 | |
| Yellow Pine | Los Angeles | *26 | *26 | *26 | De.8, De.18 Q 0.04 |
| **GOLD** | | | | | |
| Alaska Juneau | New York | | | 1½ | |
| Argonaut | Toronto | *26¼ | *24 | *24 | |
| Barry-Hollinger | Toronto | *43 | *35¼ | *43 | |
| Carson Hill | Boston | | | *35 | |
| Consol. W. Dome L. | Toronto | *15 | *14¼ | *14¼ | |
| Cresson Consol. G. | N. Y. Curb | | | 2⅜ | Mh.31, Ap.10 0.10 |
| Crown Reserve | Toronto | *14 | *10 | *10 | Jan., 1917 0.05 |
| Dome Mines | New York | 14 | 13 | 14 | Jn.30, July 20, Q 0.50 |
| Golden Center | N. Y. Curb | 3 | 2½ | 2½ | |
| Golden Cycle | Colo. Springs | †1.53 | †1.50 | | No.30, Dec.10 Q 0.03 |
| Hollinger Consol | Toronto | 18.90 | 18.85 | 18.90 | My.4, My.20 0.08 |
| Homestake Mining | New York | 54¼ | 54½ | 54½ | My.20, My.25M 0.50 |
| Kirkland Lake | Toronto | 1.10 | 1.06 | 1.08 | |
| Lake Shore | Toronto | 10.35 | 10.25 | 10.35 | Ma.1, Ma.15 Q 0.10 |
| McIntyre-Porcupine | New York | | | 25½ | My.1, Je.1 0.25 |
| Newray | Toronto | *36½ | *36½ | *36½ | |
| Night Hawk Pen | Toronto | *8 | *7 | *7½ | |
| Noranda | N. Y. Curb | 15½ | 15 | 15¼ | |
| Portland | Colo. Springs | *50 | *49 | *50 | Apr.6, Apr.15 0.02 |
| Rand Mines | New York | | | 32¾ | Fe.16, Fe.26 1.52 |
| Teck-Hughes | Toronto | 3.49 | 3.35 | 3.38 | Ja. 15, Fe. 1 0.05 |
| Tom Reed | Los Angeles | *70 | *60 | *70 | Ma.10Ma.20 0.02 |
| Tough-Oakes | Toronto | *39½ | *36½ | *38½ | |
| United Eastern | N. Y. Curb | *35 | *35 | *35 | July, 1924 0.05 |
| Vipond Cons. | Toronto | 1.62 | 1.57 | 1.57 | |
| Wright-Hargreaves | Toronto | 8.25 | 8.25 | 8.25 | Mh.15, Ap.11QX 0.07½ |
| Yukon-Alaska Trust | N. Y. Curb | | | 21½ | |
| **GOLD AND SILVER** | | | | | |
| Carnegie Metals | Boston | | | 17 | |
| Con. Cortez | N. Y. Curb | | | *5 | |
| Con. Virginia | San Francisco | *7½ | *5½ | *6½ | |
| Continental Mines | N. Y. Curb | | | *45 | |
| Dolores Esperanza | N. Y. Curb | | | *50 | July, 1923 0.05 |
| Premier Gold | N. Y. Curb | 2⅛ | 2 1/16 | 2 1/16 | Jn.18, Jy.3 Q 0.08 |
| Tonopah Belmont | N. Y. Curb | | | 2⅛ | Se.15, Oc.1 0.05 |
| Tonopah Extension | N. Y. Curb | *55 | *50 | *55 | Apr. 1925 0.05 |
| Tonopah Mining | N. Y. Curb | 5⅛ | 5⅛ | 5⅛ | Ap.7, Ap.21 Q 0.07½ |
| Unity Gold | N. Y. Curb | | | *20 | |
| West End Consol. | N. Y. Curb | *25 | *25 | *25 | Mar., 1923 0.05 |
| Yukon Gold | N. Y. Curb | | | *45 | June, 1918 0.02 |

| Stock | Exch. | High | Low | Last | Last Div. |
|---|---|---|---|---|---|
| **SILVER** | | | | | |
| Alvarado | N. Y. Curb | | | 1 | Oct., 1920 0.50 |
| Beaver Consol | Toronto | *74 | *70 | *71 | May. 1920 0.03 |
| Castle-Trethewey | Toronto | 1.42 | 1.37 | 1.37 | |
| Coniagas | Toronto | | | 3.75 | May, 1924 0.12½ |
| Keeley | Toronto | 1.58 | 1.52 | 1.52 | Ma.1, Ma.15 X 0.12 |
| Kerr Lake | N. Y. Curb | 1⅛ | 1⅛ | 1¼ | Ap.1, Ap.15 0.12½ |
| La Rose | Toronto | *14⅜ | *11 | *11 | Apr., 1922 0.10½ |
| Lorrain Trout Lake | Toronto | | | *85 | Jy. 2, Jy. 15 0.05 |
| McKinley-Dar.-Sav. | Toronto | *19 | *17½ | *19½ | Oct., 1920 0.03 |
| Mining Corp. Can. | Toronto | 3.41 | 3.31 | 3.31 | Ja. 16, Ja.30 0.12½ |
| Nipissing | N. Y. Curb | 5⅜ | 5⅛ | 5⅛ | Mh.31, Ap.20, Q 0.15 |
| Temiskaming | Toronto | *11 | *11 | *11 | Jan., 1920 0.40 |
| **SILVER-LEAD** | | | | | |
| Ahumada | New York | 8¼ | 7¾ | 8⅛ | Mh.8, Ap.5, Q X 0.25 |
| Alta Merger | Salt Lake | †*5½ | †*2½ | | |
| Bingham Mines | Boston | 32 | 30⅝ | 32 | Ma.20, Ma.31Q 1.00 |
| Cardiff M. & M. | Salt Lake | *50 | *50 | *50 | De.16, No.18 0.10 |
| Chief Consol | Salt Lake | 2.90 | 2.90 | 2.90 | Ap.1, My.1 Q 0.10 |
| Emma Silver | Salt Lake | †*50 | †*25 | | |
| Erupcion | Boston Curb | 3 7/16 | 1 7/16 | 1 7/16 | Mh.18, Ap.5, X 0.10 |
| Federal M. & S | New York | 65½ | 41 | 41 | |
| Federal M. & S., pfd. | New York | 72½ | 71 | 71 | My.25, Ju.15 Q 1.75 |
| Hawthorne Mines | N. Y. Curb | *27 | *22 | *24 | |
| Hecla Mining | N. Y. Curb | 16½ | 16¼ | 16½ | My.15, Je.15 Q 0.50 |
| Iron King Mining | Salt Lake | *25 | *22 | *22 | |
| Keystone Mining | Salt Lake | *45 | *41 | *43 | Au.12, Au.26 0.07½ |
| Lucky Jim | Spokane | *14¼ | *14¼ | *14¼ | |
| Mammoth Mining | Salt Lake | 2.80 | 2.77½ | 2.77½ | Mar.24, Apr. 1 0.10 |
| Marsh Mines | Spokane | *3⅜ | *3½ | *3½ | Se.15, Oc.1 0.10 |
| Park Utah | Salt Lake | 5.95 | 5.90 | 5.90 | Mh.15, Ap.1 0.15 |
| Prince Cons | Salt Lake | *5½ | *4 | *4 | |
| Silver King Coal | Salt Lake | 7.80 | 7.65 | 7.80 | Mh.20, Ap.1, Q 0.25 |
| Silversmith | Spokane | *49¼ | *48½ | *49 | Apr. 1, Apr.10 0.02 |
| Tamarack-Custer | Spokane | *40 | *35 | *35 | Sept., 1924 0.25 |
| Tintic Standard | Salt Lake | 12.37½ | 12.37½ | 12.37½ | Mh.1, Mh.20, QX 0.40 |
| Utah-Apex | Boston | 8¼ | 8⅛ | 8⅛ | Apr. 9, Apr. 15 0.25 |
| Western Utah Copper | N. Y. Curb | | | *8 | |
| **IRON** | | | | | |
| Bethlehem Steel | New York | 39 | 37½ | 38¾ | July, 1924 1.25 |
| Colorado Fuel & Iron | New York | 39⅞ | 37½ | 39 | May, 1921 0.75 |
| Gt. North'n Iron Ore | New York | 20 | 19¼ | 19⅜ | De. 4, De. 28, 0.75 |
| Inland Steel | New York | 37 | 37 | 37 | My.10, Je.1 Q 0.75 |
| Mesabi Iron | N. Y. Curb | 1½ | 1½ | 1½ | |
| Replogle Steel | New York | 9½ | 8¾ | 9¼ | |
| Republic I. & S | New York | 46¾ | 44 | 46 | May, 1921 1.50 |
| Republic I. & S. pfd. | New York | 92½ | 92½ | 92½ | Jn.15, July1, Q 1.75 |
| Sloss-Sheffield S. & I. | New York | 122¼ | 116¾ | 122 | Jn.10, Jn.21 Q 1.50 |
| Sloss-Shef. S.&I. pfd. | New York | | | 104 | Jn 21, July 1, Q 1.75 |
| U. S. Steel | New York | 122½ | 118½ | 122 | Jn.2, Jn 29 Q 1.75 |
| U. S. Steel pfd | New York | 128½ | 127¼ | 127½ | My.4, My.29, Q 1.75 |
| Virginia I. C. & C. | New York | 42 | 42 | 42 | Jan., 1924 1.50 |
| Virginia I.C.&C.pfd | New York | | | 73 | Jn.1, July 2, 2.50 |
| **ALUMINUM** | | | | | |
| Alum. Co. of Amer. | Open Market | 64⅜ | 63 | 63½ | |
| Alum. Co. of Amer pf. | Open Market | 99½ | 99½ | 99½ | April, Q 1.50 |
| **VANADIUM** | | | | | |
| Vanadium Corp. | New York | 35 | 33 | 34¼ | My.1, My.15, Q 0.75 |
| **ASBESTOS** | | | | | |
| Asbestos Corp., New | Montreal | 24½ | 22⅜ | 24½ | De.31, Ja.15 Q 1.50 |
| Asbestos Corp., pfd. | Montreal | 76½ | 69¾ | 76½ | De.31, Ja.15, Q 1.50 |
| **SULPHUR** | | | | | |
| Freeport Texas | New York | 32½ | 29¾ | 32½ | Nov., 1919 1.00 |
| Texas Gulf | New York | 135⅜ | 131⅛ | 134¾ | Jn.1, Jn. 15, Q 2.50 |
| **DIAMONDS** | | | | | |
| De Beers Consol | New York | | | 27½ | Ja.26, Fe.2 0.23 |
| **PLATINUM** | | | | | |
| So. Am. Gold & P. | N. Y. Curb | 4⅜ | 4⅛ | 4⅜ | |
| **MINING, SMELTING, REFINING AND GENERAL** | | | | | |
| Amer. Metal | New York | 50⅜ | 47⅛ | 50 | My.20, Je. 1, Q 1.00 |
| Amer. Metal pfd | New York | | | 113¾ | My.20, Je. 1 Q 1.75 |
| Amer. Sm. & Ref. | New York | 117 | 113½ | 116⅜ | Ap.16, My.1, Q 1.75 |
| Amer. Sm.&Ref.pfd. | New York | 116⅜ | 116⅛ | 116½ | My.7, Je.1, Q 1.75 |
| Consol. M. & S | N. Y. Curb | | | 208 | De.31, Ja.15 0.75 |
| Federated Metals | N. Y. Curb | 17½ | 17 | 17½ | |
| Newmont Mining | N. Y. Curb | | | 52 | Mar.31, Apr.15, 0.60 |
| Southwest Metals | N. Y. Curb | | | 2 | |
| U. S. Sm. R. & M. | New York | 38⅜ | 37 | 38⅜ | Ap.8, Ap.15, Q 0.87½ |
| U. S. Sm. R.&M.pfd. | New York | 49⅛ | 48½ | 48½ | Ap.8, Ap.15, Q 0.87½ |

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

## PRICE WEEK ENDED MAY 11th, 1926

| Name | High | Low | Last | Last Divd. Date | Amount |
|---|---|---|---|---|---|
| Aramayo Mines (25 frs.) | | | 8/— | May. 1926 | 5 p.c.† |
| British Platinum (£1) | | | 5/6 | Feb. 1925 | 2½ p.c. |
| Burma Corpn. (10 rupees) | | | 15/— | Feb. 1926 | 6 annas* |
| Bwana M'Kubwa (5s) | | | 7/— | | |
| Camp Bird (£1) | | | 4/9 | | |
| El Oro (£1) | | | 6/3 | Nov. 1924 | 2½ p.c.* |
| Esperanza (10s) | | | 1/3 | | |
| Frontino & Bolivia (£1) | | | 8/9 | Jan. 1926 | 1½ p.c. |
| Mexican Corpn. (£1) | | | 15/— | | |
| Mexico Mines of El Oro (£1) | | | 31/3 | Dec. 1925 | 12½ p.c.* |
| Oroville Dredging (£1) | | | 3/9 | Dec. 1923 | 3½ p.c. |
| Ouro Preto (£1) | | | 2/3 | May 1925 | 2½ p.c. |
| Rhodesian Congo Border | | | 105/— | | |
| St. John del Rey (£1) | | | 8/6 | June 1925 | 6½ p.c. |
| San Francisco Mines (10s) | | | 26/9 | Jan. 1926 | 22½ p.c. |
| Santa Gertrudis (£1) | | | 19/3 | July 1920 | 5 p.c. |
| Selukwe (2s. 6d.) | | | 10/— | April 1917 | 6¼ p.c. |
| S. Amer. Copper (2s.) | | | 4/9 | Nov. 1917 | 75 p.c. |
| Tanganyika (£1) | | | 37/6 | Sept. 1925 | 5 p.c. |
| Tomboy (£1) | | | 3/6 | Jan. 1926 | 5 p.c. |
| Union Miniere du Haut-Katanga (Brussels) | 6.000 | 5.925 | 6.825 | July 1925 | 150 frs.‡ |

* Free of British income tax. † Swiss frs. ‡ Belgian frs.